

## MEASURING INSTRUMENTS



Tensiometer (Soil Moisture)  
 Watermark (Soil Moisture)  
 Capacitance (Soil Moisture)  
 Scholander Chambers  
 Dendrometer  
 Radiation  
 Precipitation & Water Level  
 Frost- & Temperature Monitoring  
 IoT4H2O - Universal  
     Data Acquisition with IoT  
 Weather Stations  
 Suction Lysimeter  
 Nutrient Analysis  
 pH Measurement  
 EC Measurement  
 DO Gauges  
 Multi-parameter Measurement  
 Soil Investigation - Tools

## PRODUCT CATALOGUE

CURRENT PRICES

CAN BE FOUND IN OUR WEBSHOP

## **IMPRINT**

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## Welcome to MMM tech support

Your specialist for measuring instruments for professional plant production, urban green, research, consulting and water management.

Our work is dedicated to the responsible use of natural resources, especially water.

The need to use natural resources sparingly and thoughtfully is undisputed. Every use of energy, water, fertilizers and pesticides must be weighed carefully, planned and increasingly justified to authorities and consumers alike.

However, only those who know the current situation exactly can also react, plan and manage optimally... Only based on a solid information basis can optimization potential be recognized and implemented. Measuring instruments from MMM tech support create this information basis.

MMM tech support supports you with measuring instruments that are optimally adapted to your needs. Our delivery program covers the whole range from simple, economical handheld devices to comprehensive high-end solutions.



## OUR PARTNERS:

EXCLUSIVE DISTRIBUTION IN CENTRAL & EASTERN EUROPE

Irrrometer® Inc.

**IRR**METER®

EXKLUSIVE DISTRIBUTION IN CENTRAL EUROPE

PMS® Instruments



PMS Instrument Company

DISTRIBUTION IN CENTRAL EUROPE

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## General

The exact scheduling of irrigation is very important because:

- Both, too high and too small water applications result in negative effects on yield, plant health and environment.
- Nutrient availability and uptake are influenced strongly by soil moisture conditions.
- Each irrigation event is causing cost.

Benefits of exact irrigation scheduling are therefore

- increased yield
- improved quality
- savings in money and natural resources.

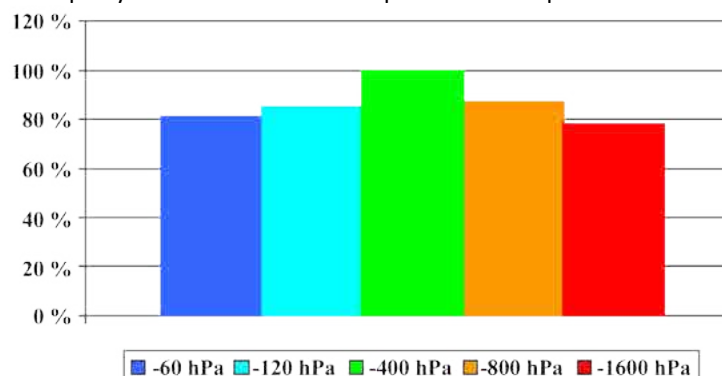
Necessary for appropriate irrigation scheduling are:

- exact determination of irrigation frequency
- exact determination of irrigation water amount

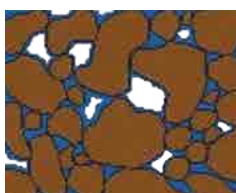
To collect this information, various approaches are common.

Following some background information, these approaches will be discussed briefly.

Example: yield-effect of soil water potential in raspberries



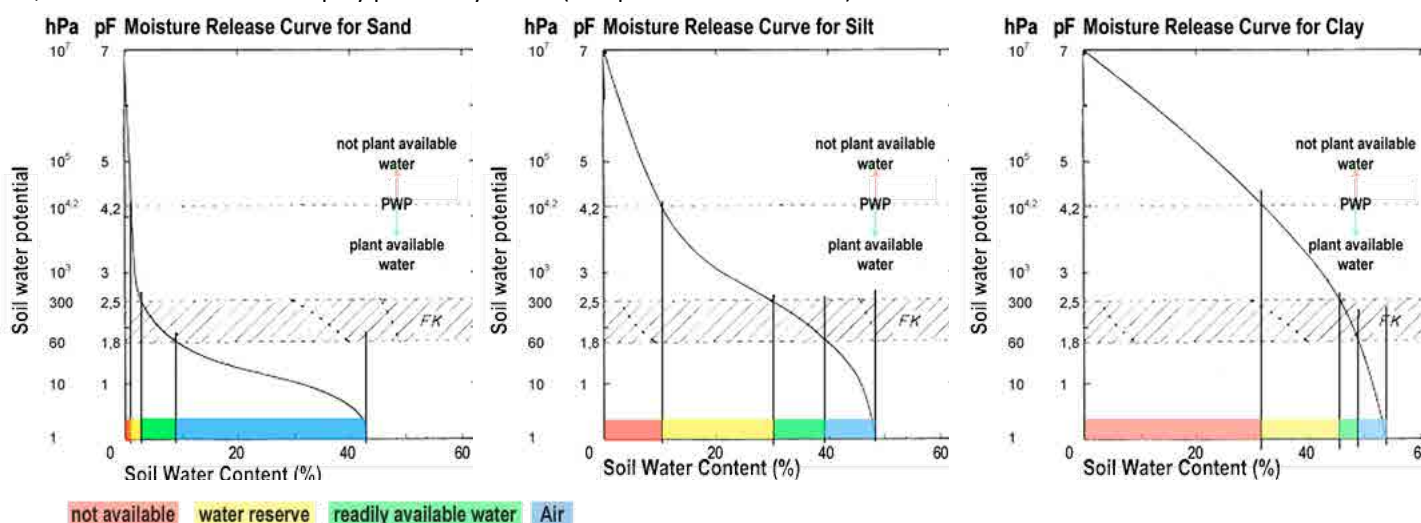
## Soil and Soilwater



Soil consists of soil particles (mineral or organic) and the soil pores, which are either filled with water or air. Depending on the average size of soil particles (soil type), structure, compaction and organic matter content, total pore volume greatly varies from soil to soil. Total pore volume is key factor for water storage capacity of any soil.

The narrower the diameter of water filled pores, the stronger the force with which water is bound by soil, and plants have to apply more energy to extract it. This force is called soil water potential or soil water suction.

The term fieldcapacity refers to the amount of water a soil can hold back against gravity (the soil water content at a soil water potential of approx. 60 hPa or pF 1,8). Plant usable fieldcapacity is the amount of water, bound in soil with a soil water potential between 60 (pF 1,8) and 15 000 hPa (pF 4,2), i.e. Plant usable field capacity equals field capacity minus the water, which is bound so strongly in soil, that it can not be taken up by plants any more. (non plant available water).



Due to above described circumstances the amount of plant available soil water is varying strongly between soils. Example: Plant available water of a typical sand ranges between approx. 5 and 15% absolute water content, while plant available water of a typical clay soil ranges between approx. 30 and 50% water content.

## Irrigation scheduling Approaches

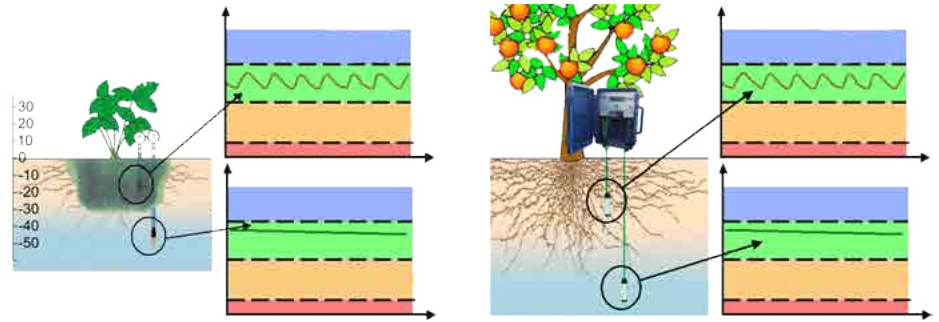
### A - Measurement of Soil Water Potential

This approach measures the soil water potential as indicator of water availability for plant uptake in soils. Measuring soil water potential provides information on the force with which water is bound by soil (= energy plants have to apply to extract it), but it gives no information on the amount of water contained in this soil. Common measurement units for soil water potential are hPa (1 hPa = 1 mbar) and kPa (1 kPa = 1 Centibar = 10 hPa / mbar).

Measuring soil water potential is the classical approach of irrigation scheduling. It is possible to transfer values of soil water potential from soil type to soil type, i.e. it is of minor importance in which soil a measurement is taken. For example a measured soil water potential of 150 hPa results in the same information whether this measurement has been taken in a sand or in a clay soil. Clearly defined optimum ranges do exist for all major crops, and crop development stages, which are valid for all soil types. For best results

Tensiometer and Watermark Sensor are instruments to measure soil water potential. Tensiometers yield very accurate results in the moist end of the range (0 to approx. 800 hPa), and are successfully used in almost all growing systems and crops, grown in mineral soil and substrates. Tensiometers show best results in drip irrigation systems.

Good irrigation scheduling results in optimal moisture conditions and nutrient availability in the whole main root-zone, without losses due to deep percolation.



Pictures: blue: - too wet; green - optimal moisture; orange / red - too dry

## B - Measurement of Volumetric Soil Water Content

This approach uses instruments to measure the volumetric water content of soil. It yields information on the total water content, including the not plant available part of it in a given unit of soil. This approach provides no information on the energy which is necessary to extract water from this soil. Common units in volumetric measurement are mm, Vol. % or liter of water per liter or m<sup>3</sup> of soil.

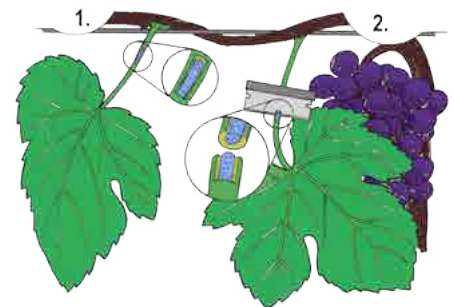
Volumetric measurement values can not be transferred between different soil types. Example: The measurement result of 30% water content would mean for a sand saturation (soil water potential approx. 10 hPa or pF 1,0), while a silty soil would show a soil water potential of approx. 300 hPa or pF 2,5. A clay soil at 30% water content would be close to the permanent wilting point (soil water potential approx. 15000 hPa or pF 4,2).

TDR Fieldscout and FDR Sensors are instruments to measure the volumetric soil water content. Volumetric probes and measurement instruments are the ideal tool to answer the question how much water to apply per gift.

## C - Measurement of Leaf- and Stem Water Potential

This approach measures directly the leaf- or stem water potential, the tension of the xylem water in a plant, with a Scholander pressure chamber. It provides direct information on the water status of a plant, and thus on water availability in the whole rooted zone of this plant. Common measurement units are MPa and bar. (1 MPa = 10 bar).

Values from measurements with a Scholander chamber can be transferred between sites. Clearly defined optimum ranges do exist mainly for trees and vines. The measuring process itself however is labour intensive and can not be automated. Scholander chambers are most commonly used in grape production and research.



1. Xylem water column in a plant is always under tension  
2. When cut, water column retreats into leaf

## D - Climatic Water Balance

The climatic water balance (also Geisenheimer Methode) is an indirect approach. Based on environmental data, the potential evapotranspiration (= transpiration of plants + evaporation from soil) is calculated for a specific area and time period (most common formula: Penman-Monteith). In a second step, this value is corrected with an empirical factor K<sub>c</sub> (K<sub>c</sub> determined by crop and development stage) to the actual evapotranspiration. Finally eventual rainfall is subtracted.

The climatic water balance yields information on the water loss in mm over a given period of time. The calculation must be performed for every individual field and crop. For most crops and crop development stages various K<sub>c</sub> correction factors do exist. Some of the iMetos automatic weather station models offer an automated climatic water balance.

Example:

|   | Datum      | K <sub>c</sub> | ET <sub>0</sub> | ET <sub>c</sub> | Regen, mm | Regen eff. | Beregn. eff., % | Beregn., mm | Wasserbilanz, mm |
|---|------------|----------------|-----------------|-----------------|-----------|------------|-----------------|-------------|------------------|
| 🌳 | 2007-04-20 | 0.500          | 4.471           | 2.236           | 0         | 0.95       | 90              |             | -2.236           |
|   | 2007-04-21 | 0.512          | 4.214           | 2.157           | 0         | 0.95       | 90              |             | -4.393           |
|   | 2007-04-22 | 0.524          | 4.640           | 2.430           | 0         | 0.95       | 90              |             | -6.823           |
|   | 2007-04-23 | 0.536          | 4.959           | 2.657           | 0         | 0.95       | 90              |             | -9.480           |
|   | 2007-04-24 | 0.548          | 4.686           | 2.566           | 0         | 0.95       | 90              |             | -12.046          |
|   | 2007-04-25 | 0.560          | 5.170           | 2.893           | 0         | 0.95       | 90              |             | -14.938          |
|   | 2007-04-26 | 0.571          | 5.360           | 3.063           | 0         | 0.95       | 90              |             | -18.001          |
|   | 2007-04-27 | 0.583          | 5.226           | 3.048           | 0         | 0.95       | 90              |             | -21.049          |
|   | 2007-04-28 | 0.595          | 5.128           | 3.052           | 0         | 0.95       | 90              |             | -24.102          |

Tensiometers are ideal for irrigation scheduling of drip irrigation systems and are field approved since many decades.

## Tensiometer Advantages:

A tensiometer offers many advantages for irrigation scheduling:

- Low cost
- Very accurate measurement value, even at low soil waterpotentials
- Easy interpretation of values
- Result is valid for all soil types
- Result not influenced by EC value of soil solution

## Typical Applications

strawberry and softfruit, vegetables, asparagus, hops and fruit trees in open field, tunnels and glasshouses. tree- and grape-nurseries, scientific applications

## MMM ® TENSIO METER



### MMM Tensiometer T1 Series

The economic solution for protected cultivation (open field also)

[MMM Tensiometer T1 Series](#)



### MMM Tensiometer T2 Series

The economic solution for cultivation in open field

[MMM Tensiometer T2 Series](#)



### MMM Tensiometer T2D Series

T2 Tensiometer with digital pressure gauge

[MMM Tensiometer T2D Series](#)



### MMM Tensiometer TX Series

Top Class Tensiometer - Fast & Robust

[MMM Tensiometer TX Series](#)



### MMM Tensiometer TXA Series

Top Class Tensiometer - Fast & Robust with Alumina Ceramic Tip

[MMM Tensiometer TXA Series](#)



### MMM Tensiometer TX-E Series

Electronic tensiometer  
with mV signal

[MMM Tensiometer TX-E Series](#)



### MMM Tensiometer TXSU Series

Top class tensiometer for substrate cultivation

[MMM Tensiometer TXSU Series](#)



### MMM Switch-tensiometer TXS series

Tensiometer for irrigation automation

[MMM Switch-tensiometer TXS series](#)

## MMM ® TENSIO METER

### MMM Tensiometer T1 Series

- ✓ Self-explanatory color coding
- ✓ Quick and easy interpretation
- ✓ Always-tight silicone stopper
- ✓ Readable from top or front

### MMM Tensiometer T2 Series

- ✓ Robust shaft
- ✓ High water holding capacity
- ✓ Always-tight silicone stopper
- ✓ Readable from top or front

### MMM Tensiometer T2D Series

- ✓ Digital pressure gauge
- ✓ Insensitive to tampering
- ✓ Automatic switch-off
- ✓ Readable from top

### MMM Tensiometer TX Series

- ✓ Virtually maintenance-free
- ✓ Unparalleled rapid response
- ✓ Air can be completely evacuated
- ✓ Readable from top

### MMM Switch-tensiometer TXS

- ✓ Switching Tensiometer TX
- ✓ For all solenoids and computers
- ✓ Fixed or adjustable switching point
- ✓ For AC and DC systems

## SPARE PARTS

## FOR MMM® TENSIDOMETER

**T1 Shaft**

T1 Shaft, length 20,30,50,60,90 cm

[T1 Shaft](#)**T1 Pressure gauge**

T1-M-v read from side

T1-M-q read from above

[T1 Pressure gauge](#)**Service pump for TX**

Service pump for TX tensiometer

[Service pump for TX](#)**TX Shaft**

lengths 15, 20,30,50,60,90 cm

[TX Shaft](#)**TX Pressure Gauge****for tensiometer:**

Type TX6 : (0-600 hPa)

Type TX10: (0-1000 hPa)

[TX Pressure Gauge](#)**TXA Shaft**

lengths: 15, 20, 30,50,60,90 cm

[TXA Shaft](#)**T2 Pressure gauge**

manometer read from side

SKU. T2-M-v

[T2 Pressure gauge](#)**T2 Pressure gauge**

manometer read from above

SKU. T2-M-q

[T2 Pressure gauge](#)**Linear pressure transducer**

for TX-E tensiometers,

incl. 5 V power supply

[Linear pressure transducer for TX-E](#)**T2 Shaft**

T2 Shaft, length 20,30,50,60,90 cm

[T2 Shaft](#)**TXSU Pressure gauge 0-250 hPa**

Pressure gauge 0-250 hPa for TXSU tensiometer

[TXSU Pressure gauge 0-250 hPa](#)**T2D Shaft**

lengths: 20,30,50,60,90 cm

[T2D Shaft](#)**TXS switchbox**

Switchbox for TXS Tensiometers

[TXS switchbox](#)**T2 digital pressure gauge**

digital pressure gauge for tensiometer T2D

[T2 digital pressure gauge](#)**TXS Shaft**

Shaft for TXS tensiometers, lengths 15, 20,30,50,60,90 cm

[TXS Shaft](#)

# IRROMETER®

Tensiometers from the manufacturer Irrometer®, have been built for over 65 years and meet the highest demands.

Irrometer Tensiometers are equipped with a waterproof stainless steel pressure gauge with improved pressure compensation.

The shaft has an integrated water reservoir to replace lost water at any time in the field.

The ceramic tip is replaceable.

The tensiometer is filled air-free for operation and thus reacts particularly quickly to changes in soil water tension.

Recommended accessories:

Irrometer service pump

## IRROMETER® TENSIO METER



### Irrometer® Tensiometer IR Series

Tensiometer of highest standards

[Irrometer® Tensiometer IR Series](#)



### Irrometer® Tensiometer IR-LT Series

Tensiometer especially for substrates

[Irrometer® Tensiometer IR-LT Series](#)



### Irrometer® Mini Tensiometer Type IR-MLT

Optimal for substrate containers and grow bags

[Irrometer® Mini Tensiometer Type IR-MLT](#)



### Irrometer® Tensiometer IR-E Series

Electronic Irrometer® Tensiometers with mV signal

[Irrometer® Tensiometer IR-E Series](#)



### Mini Irrometer with E-pressure transducer IR-E-MLT

Electronic mini Irrometer with mV signal

[Mini Irrometer with E-pressure transducer IR-E-MLT](#)



### Irrometer Pumps

The complement for every tensiometer from Irrometer.

#### Service Pump IR-SP

without manometer:

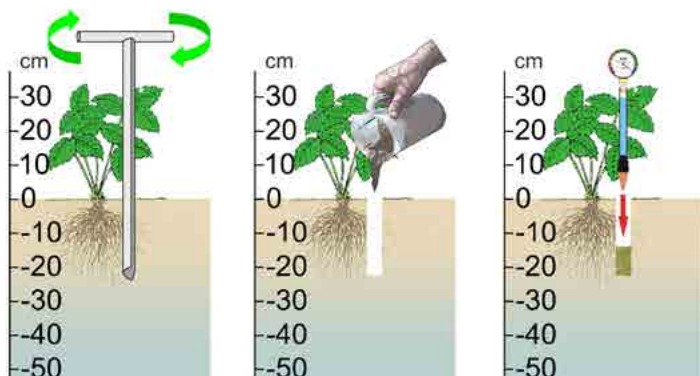
[Irrometer Service Pump Type IR-SP](#)



#### Test Pump IR-TP with manometer:

[Irrometer Test Pump IR-TP](#)

## INSTALLATION OF TENSIO METER



## SPARE PARTS

## FOR IRROMETER®

**Irrrometer Shaft without gauge**

Shaft without pressure gauge for  
Irrrometer tensiometer

lengths 15,30,45,60,90 cm

[Irrrometer Shaft without gauge](#)

**IR-MLT pressure gauge**

IR-MLT-M, Manometer for MLT mini  
tensiometer

[IR-MLT pressure gauge 0 to 40 kPa](#)

**Irrrometer screw cap**

complete with plug

[Irrrometer screw cap complete with plug](#)

**Irrrometer E-Sensor IR-E, IR-E-LT**

IR-RSU-V, Irrrometer E-Sensor /  
pressure transducer  
for IR-E, IR-E-LT

[Irrrometer E-Sensor for IR-E, IR-E-LT](#)

**Irrrometer stopper**

Irrrometer stopper for screw cap

all IR tensiometers

Pack of 10

[Irrrometer stopper for screw cap, pack of 10](#)

**Irrrometer O-rings, pack of 10**

Irrrometer O-rings for screw cap,  
pack of 10

[Irrrometer O-rings, pack of 10](#)

**Irrrometer pressure gauge**

IR-M, standard manometer for IR  
tensiometers (0-100 Centibar)

[Irrrometer pressure gauge](#)

**Irrrometer ceramic tip for IR**

IR-KS, Ceramic tip standard for IR  
tensiometers

[Irrrometer ceramic tip](#)

**LT Pressure gauge 0 to 40 kPa**

IR-LT-M, Manometer for IR-LT (0-40  
kPa)

[LT Spare pressure gauge 0 to 40 kPa](#)

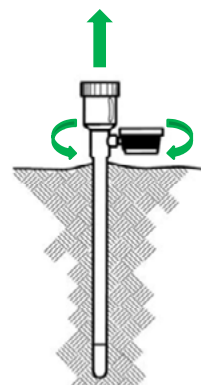
**IR-MLT shaft with ceramic tip**

IR-MLT-BO, Shaft for IR-MLT, 12 cm

[IR-MLT shaft with ceramic tip](#)

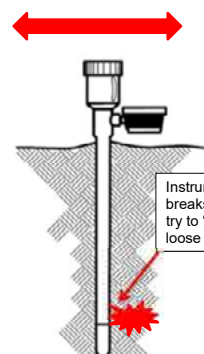
## RETRIEVAL OF TENSIO METER

Correct retrieval:



**Correct:** Pull Tensiometer straight up. You may turn it in soil to loosen contact. If soil is dry, it is helpful to pour water before retrieval around the instrument to soften the soil.

Not Correct retrieval, never do:



Instrument easily breaks here if you try to "wiggle" it loose from ground.

**Wrong:** Never wobble the Tensiometer sideways to try to loosen it from soil. If you do you might break the shaft or ceramic at the bottom of the instrument.

## IRROMETER®

### Watermark Sensors

- ✓ Robust, user-friendly sensor
- ✓ Maintenance free
- ✓ Frost-proof
- ✓ Buffered

### Watermark Profile Probes

- ✓ 3 or 4 sensors in 1 shaft
- ✓ For measuring multiple soil layers
- ✓ Monitoring over complete profile
- ✓ Various lengths available

The use of Watermark Granular Matrix Sensors is specifically recommended for situations with longer time lags between water applications, i.e. in situations with higher fluctuation of soil moisture, for example in cases like irrigation by irrigation machines or in crops which need some degree of water stress or which are generally cultivated at the drier end. Besides the read-out equipment by Irrometer, Watermark Sensors also can be easily incorporated in many other data collection systems.

### Advantages

Watermark Sensors measure soil water potential between 0 and 239 Centibar (0-239 kPa), are maintenance free and frost proof, and are buffered against varying salt content (EC value) in soil solution. Interpretation of data is easy, since measurement result is valid for all soil types. Watermark Sensors are durable and low cost, offer an accurate measurement result and have been field approved since decades.

### Working Principle

Watermark Sensors consist of two electrodes, which are embedded in a special granular matrix. The sensors are protected by a stainless steel cover. Surrounding soil and the granular matrix inside a Watermark Sensor come to an equilibrium of soil water potential. The granular matrix has a varying resistance to electrical power (AC), depending on it's moisture content. This resistance is converted by the readout meter into soil water potential (unit Centibar).

### Typical Applications

Irrigation scheduling in vegetables, asparagus and softfruit, irrigated by an irrigation machine, irrigation scheduling in vineyards, fruit trees, hops, potatoes, sugar beet, arable agriculture and seed production. Use in golf, garden and landscape irrigation.

## IRROMETER®

### Watermark® Sensor

The maintenance free sensor by Irrometer®

abbr. WM

[Watermark Sensor](#)



### Watermark® as Profile Probe

measurement depths:

WM-3S 15-30-60cm

WM-4S 15-30-60-90cm

[Watermark Profile Probe for multiple depths](#)



### Watermark® Sensor voltage adaptor

ideal for developers and OEM applications

[Watermark Sensor voltage adaptor](#)



### SDI-12 Adaptor for Watermark® sensors

Watermark SDI-12 adapter board

[SDI-12 Adaptor for Watermark sensors](#)



### Watermark® SDI-12 Bus Box

Integrates watermarks flexibly into external systems

**New**  
WM-SDI-12 BusBox



### WM-HH - Handmeter

for Watermark® Sensors

Basic readout device for Watermark sensors

[Handmeter for Watermark Sensors](#)



### Watermark Monitor

Watermark®. WM-M0; device only.

WM-MK (7 WM sensors, 1 soil temperature)

[Watermark Monitor](#)



### Waterswitch control units

Soil moisture based irrigation automation by Irrometer®

[Waterswitch control units](#)





### Watermark® SDI-12 Bus Box

Integrates watermarks flexibly into external systems

Watermark® sensors have become the standard for monitoring the water needs of urban trees and green spaces. However, the original signal from these sensors cannot be read by many simple IoT data acquisition devices. The new Watermark® SDI-12 Bus Box offers a simple, turnkey solution for this issue.

The integrated chip converts the original signal from three Watermark sensors and one soil temperature sensor into a SDI-12 signal with clear values (in kPa or °C). This makes it possible to easily acquire data from Watermark sensors with virtually any SDI-12-compatible data acquisition device and integrate them into third-party systems.

The Watermark® SDI-12 Bus Box is offered as a complete package including three Watermark sensors and one soil temperature sensor and is distributed exclusively in Germany and Central Europe by MMM tech support GmbH & Co KG. This significantly simplifies the integration of Watermark® sensors into third-party systems and makes it possible even for users without in-depth electronics knowledge.

### SPARE PARTS



#### PVC Installation Tube for WM Sensors WM-HR

Length: 20,30,50,60,75,90 cm mounted to sensor

[PVC Installation Tube for WM Sensors](#)



#### Replacement cable for Watermark Handmeter

WM-HH-K, replacement cable for handmeter WM-HH

[Replacement cable for Watermark Handmeter](#)

Volumetric sensors measure the water content in soil, providing information on the amount of water currently contained in the soil, including the not plant-available water.

When interpreting volumetric readings, the soil type must be considered, and generally applicable optimum ranges are not available. Common units are Vol.% or mm water per liter or m<sup>3</sup> of soil.

## Advantages

- Soil specific calibration possible
- Information about the amount of water contained in the soil
- very accurate measuring technique
- immediate reaction to changing moisture conditions in the soil.
- maintenance-free and frost-proof sensors

## Functionality

We offer sensors and devices based on the measuring techniques TDR (Time Domain Reflectometry) and FDR (Frequency Domain Reflectometry).

## Working Principle TDR

TDR (Time Domain Reflectometry) sensors determine the water content in the soil by measuring the dielectric properties of the soil by measuring the travel time of an electromagnetic pulse through conductors located in the soil.

The speed at which the electromagnetic pulse propagates in the soil depends on its dielectric properties, and thus its water content.

The measured value of the transit time is then automatically converted into volumetric soil water content.

## Working Principle FDR

FDR (Frequency Domain Reflectometry) sensors measure the dielectric properties of the soil using typically two electrodes. The readout device „checks“ returning electromagnetic waves for deviations in the frequency range and thus ultimately determines the water content in the soil.



## TDR



### TDR Fieldscout 150

Mobile measuring device for water content and EC value

[TDR Fieldscout 150](#)



### TDR Fieldscout 350

Mobile measuring device for water content and EC value

[TDR Fieldscout 350](#)



### TDR-N Measuring Rods

for TDR-150 and TDR 350.

Lengths: 3,8 - 7,5 - 12 - 20 cm

[TDR Fieldscout Measuring Rods](#)

## FDR SENSORS

### SMT-50 Sensor

for vol. Water content and soil temperature with an analog volt signal

[SMT-50 Sensor](#)



### SMT-100 Sensor

for vol. Water content and soil temperature with digital interface

[SMT-100 Sensor](#)



### SM-100 FDR Sensor

FDR Sensor with Analog Volt Signal

[SM-100 FDR Sensor](#)



### EC05V Sensor

small size and compact FDR Sensor, based on EC-5

[EC05V Sensor](#)



## FDR SENSORS



### MEC10 Sensor

Economic sensor for VWC, EC & Temp. with SDI-12 signal

[MEC10 Sensor](#)



### MT22A Sensor

Sensor for VWC, EC & Temp. SDI-12 use in all common growing media, based on Meter Teros-12

[MT22A Sensor](#)



### SMEC-300 Sensor

FDR Sensor for volumetric water content, temperature and conductivity with Analog Volt Signal

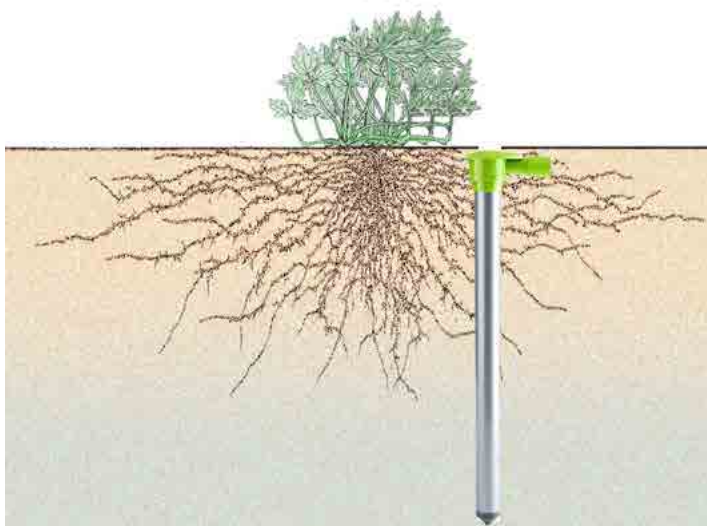
[SMEC-300 Sensor](#)



### Aquacheck Profile Probe

FDR profile probe for measuring soil water content and temperature at multiple depths. Multitude of Configurations, lengths and sensor distances

[Aquacheck Profile Probe](#)



## DEVICES FOR FDR SENSORS



### EC-HH-Pro Handheld Meter

for Meter Group Sensors like ...

[EC-HH-Pro Handheld Meter](#)



### SM-HH Handheld reader

for the sensors SM-100 &

SMEC-300

[SM-HH Handheld reader](#)

## Data acquisition of capacitance probes

We offer the **IoT4H2O® devices** as data acquisition devices.

### Typical applications

- Scientific applications
- Investigation of the influence of environmental factors on plant growth
- monitoring in urban green applications
- irrigation control and monitoring
- and much more. Please contact us.

## COMPATIBLE DEVICES



### IoT4H2O® base unit with NB-IoT radio

The turnkey solution

[IoT4H2O® devices NB IoT](#)



### IoT4H2O® base unit with LoRaWAN radio

The solution for integrators and developers

[IoT4H2O® device LoRaWAN](#)

## Scholander chambers

A measurement with the Scholander chamber means that the plant provides direct information about its water status.

This measuring technique goes back to work of P.F. Scholander in 1965. The manufacturer of our devices was founded as the world's first commercial manufacturer of Scholander chambers back in 1967 by two of his students.

Due to this long experience, our devices offer unmatched safety and a well thought-out, very user-friendly handling.

## Advantages

The plant itself, not the soil, provides information about its water status, and thus decides whether irrigation is necessary. With the help of measured values from a Scholander chamber, well-founded conclusions can be drawn about the water availability in the entire root zone of the plant.

## How it works

When measuring with a Scholander chamber, the leaf water potential (or the tension of the xylem sap in a plant) is determined directly by cutting a leaf before sunrise and enclosing it airtight in the pressure chamber. Only the cut end of the petiole protrudes slightly from the chamber.

The leaf is then pressurized in a slowly increasing manner. As soon as water begins to show at the cut end, equilibrium is reached, i.e. the pressure in the chamber corresponds to the tension under which the water flow of this leaf was at the plant before the cut. At the same time, this value corresponds to the water potential in the entire root zone of the plant.

## Stem Water Potential

Another method is the measurement of the so-called stem water potential. Here, the leaf to be measured is enclosed airtight in a mirrored plastic bag before measurement. Since no gas exchange is possible due to the plastic bag, the equilibrium between the leaf water potential of this leaf and the stem water potential of this plant is established after a certain period of time and can be measured.

The big advantage of this approach is that the measurement does not have to be done before sunrise, but can be done during the day.

## Typical applications

Scholander chambers are most commonly used in viticulture and fruit trees, as well as in research and in the development of drought-resistant varieties. Also, herbaceous plants and grasses can be measured in this way.

## DEVICES



### Scholander Chamber Model PMS

mobile instrument with integrated Air Pump

[Scholander Chamber Model PMS](#)



### Scholander Chamber Model M-600

Handy and light for pressure up to 40 bar

[Scholander Chamber Model M-600](#)



### Scholander Chamber Model M-615

portable, boxed, Pressure Tank integrated

[Scholander Chamber Model M-615](#)



### Scholander Chamber Model M-1000

pressure up to 70 bar

[Scholander Chamber Model M-1000](#)



### Scholander Chamber Model M-1505D

Pressure up to 100 bar with digital display

[Scholander Chamber Model M-1505D](#)



### Scholander Chamber Model M-1515D

Pressure up to 100 bar, pressure Tank integrated

[Scholander Chamber Model M-1515D](#)



### Scholander Chamber Model M-1505D-EXP

M 1505D & Cavitation Chamber Combo unit

[Scholander Chamber Model M-1505D-EXP](#)



### Stem Water Potential Bags SKB

for measuring the stem water potential - (10 pcs)

[Stem Water Potential Bags SKB](#)

## SPARE PARTS FOR PMS

**PMS-MA Manometer**

for Scholander chamber PMS:

PMS-MA-20 (0-20 bar, standard)

PMS-MA-06 (0-6 bar)

[PMS Manometer](#)

**PMS-LID Lug Lid Sealing system**

for Scholander chamber PMS:

PMS Lid-13 for 1-3 mm petioles

PMS Lid-36 for 3-6 mm petioles

[Lug Lid Sealing system PMS](#)

**PMS-Lid-G**

for Scholander chamber PMS:

Lug Lid sealing system for bladed  
leafes (grain / grass) up to 15mm

[Compression Gland Sealing System](#)

**M-DT4 External pressure tank**

for all Scholander chambers model M:

(4,0 liter / DIN 477-1, compressed  
air) up to 200 bar,

[External pressure bottle with handle](#)

## SPARE PARTS FOR MODEL M

**Compression Gland Gasket****M-STOP**

for all Scholander chambers model M:

for round petioles

[Compression Gland Gasket round petioles](#)

**Compression Gland Gasket****M-STOP grass**

for all Scholander chambers model M:

up to 18mm

[Compression Gland Gasket, grass](#)

**M-DG Conversion kit for lid:**

for all Scholander chambers model M:

blades grain, width up to 18mm

[Conversion kit for lid: blades grain.](#)

**M-D Conversion kit for lid:**

for all Scholander chambers model M:

M-D12 round pet. 6 to 12 mm (1/2")

M-D9 round peti. 3 to 9 mm (3/8")

M-D6 round pet. 1 to 6 mm (1/4")

M-D3 round pet. 0,5 to 3 mm (1/8")

[Conversion kit for lid: round petioles](#)



Dimensional changes of plant organs are the result of growth and reflect, among other things, changes in water content in the plant body, which are influenced by environmental factors and cultural measures.

Accurate knowledge of this relationship is of great importance for research as well as for practice in order to achieve optimal yields and quality.

Dendrometer are instruments for continuous measurement of plant growth: changes in diameter and circumference of shoots, branches or stems, and for measuring the diameter of fruits and vegetables.

Data from dendrometer document plant responses to the environment with high accuracy.

## Non invasive...

Due to the injury-free measuring method the stress on the plant is reduced to a minimum.

Temporally high-resolution, continuous recordings of the data with a data acquisition device, allow the exact allocation of plant reactions to environmental influences and cultural measures such as irrigation applications.

## Data acquisition of dendrometer

We offer the **IoT4H2O® devices** and **iMetos stations** as data acquisition devices.

## Typical applications

- Scientific applications
- Investigation of the influence of environmental factors on plant growth
- monitoring of plant growth processes
- Non-invasive monitoring of the water status of plants, also for irrigation control
- Accurate dating of the beginning and end of the growing period



### Dendrometer DD-S

for diameters shoot and trunk

diameters 0 to 5cm

[Dendrometer Model DD-S](#)



### Dendrometer DC-2

for trunk circumference (trees)

circumference 5cm or larger

[Dendrometer model DC-2](#)



### Dendrometer DF

for diameters fruit and vegetables

diameters 0 to 11 cm

[Dendrometer model DF](#)

## IoT4H2O



### IoT4H2O® base unit

with NB-IoT radio

The turnkey solution

[IoT4H2O® devices NB IoT](#)



### IoT4H2O® base unit

with LoRAWAN radio

The solution for integrators and developers

[IoT4H2O® device LoRaWAN](#)

## WEATHERSTATIONS...



### iMetos 3.3 weather station

High-end weather stations with maximum flexibility

[iMetos 3.3 weather station](#)



### Metos 5 weather station

High-end weather stations with maximum flexibility

extended connectivity

[Metos 5 weather station](#)

As the driving force of photosynthesis, light is of critical importance to plants. Plant growth and development is significantly affected by both the amount and type of Radiation.

Traditionally, light is thought of as a high-frequency electromagnetic wave. In quantum physics, light is no longer regarded as a classical wave, but as a quantum object.

Accordingly, light is composed of individual energy quanta, the photons. Photons are measured in moles ( $1 \text{ mol} = 6,02 \times 10^{23}$ ).

For agricultural and horticultural applications, the intensity radiation is measured in different wavelength ranges:



**Pyranometer / Global radiation** (wavelength range about 300 to 1100 nanometers), represents the total irradiation from the sun. Measurement of global radiation are used for Et calculation and solar energy utilization. Unit: watts per  $\text{m}^2$ .

**PAR radiation** (wavelength range approx. 380 to 780 nanometers), maps the wavelengths used primarily by plants for photosynthesis (PAR = Photosynthetic Active Radiation). Their measurement complements statements about plant growth conditions. Unit:  $\mu\text{mol}$  photons per  $\text{m}^2$ .

**UV radiation** (wavelength range approx. 250 to 400 nanometers). UV radiation triggers stress reactions in humans, animals and plants (e.g. sunburn), measurements are further used to determine the UV filtering capacity of greenhouse shading and heat protection glazing. Unit:  $\mu\text{mol}$  photons per  $\text{m}^2$ .

## DEVICES



### Handheld meter for PAR radiation

LS-PAR: meter with integrated sensor, range 0 - 2000  $\mu\text{mol}/\text{s} \cdot \text{m}^2$

[Handheld meter LS-PAR](#)



### Handheld meter for UV radiation

LS-UV: meter with integrated sensor, range 0 - 200  $\mu\text{mol}/\text{s} \cdot \text{m}^2$

[Handheld meter for UV radiation LS-UV](#)



### WatchDog Micro weather station

Micro weather station for various parameters from Spectrum

[WatchDog Micro Weather Station](#)

## SENSORS



### Sensor for Global radiation Pyranometer LS-GLO-S

for WatchDog and other devices  
Single sensor on leveling plate

[Sensor for global radiation LS-GLO-S](#)



### Sensor for PAR radiation LS-PAR-S

for WatchDog and other devices  
Single sensor on leveling plate

[Sensor for PAR radiation LS-PAR-S](#)



### Sensor for UV radiation LS-UV-S

for WatchDog and other devices  
Single sensor on leveling plate

[Sensor for UV radiation LS-UV-S](#)



## Downloads

Light Brochure

[Download](#)

# PRECIPITATION & WATER LEVEL

Height and intensity of precipitation are central parameters of growing conditions. Since the height and intensity of precipitation can also vary greatly over small areas, a small-scale high-resolution measurement of rain is very useful.

Measuring instruments for rain with and without remote data transmission are available.

## DOWNLOADS ON SENSORS:

about WM-M-RG

**Raingauge Manual EN**

[Download](#)

**Raingauge Specs sheet EN**

[Download](#)

about NMETOS100

**nMetos Leaflet EN**

[Download](#)

about WLS-0-5

**WLS Datasheet EN**

[Download](#)

**WLS Datenblatt DE**

[Download](#)

## PRECIPITATION



### Rain gauge MM-ND

Plastic rain gauge with stick holder.  
range 0 to 40mm

[MM-ND Rain gauge](#)



### Rain gauge WM-M-RG

(Davis Aerocone®) for integration in many applications like WM Monitor and IoT devices

[Rain gauge WM-M-RGs](#)



### Rain gauge NMetos 100

Rain gauge with integrated NB IoT data transmission for integration in applications like Metos weatherstations

[NMetos 100 Rain gauge](#)

## WATER LEVEL



### Waterlevel sensor WLS

Water level sensor is suitable for monitoring the water level in water tanks

[Waterlevel - Sensor WLS](#)

## DATA ACQUISITION - COMPATIBLE DEVICES



### Watermark Monitor

**WM-M0/ WM-MK**

compatible to WM-M-RG

[Watermark Monitor](#)



### IoT4H2O® base unit

**with NB-IoT radio**

compatible to:

WM-M-RG, NMETOS100, WLS-0-5

[IoT4H2O® devices NB IoT](#)



### IoT4H2O® base unit

**with LoRaWAN radio**

compatible to:

WM-M-RG, WLS-0-5

[IoT4H2O® device LoRaWAN](#)

Temperature is an important parameter in numerous applications.

Temperature has a decisive influence on the growth of plants. In addition, plants, especially during flowering can be massively damaged by too low as well as too high temperatures.

Therefore, accurate and timely data on the temperature development is of great importance.

In order to obtain meaningful data, however, it must be ensured that a suitable temperature sensor is used.

- Frost warning for tree and soft fruit: measurement of wet- and drybulb temperature
- Frost warning for early potatoes: measuring the temperature directly under the cover
- Air temperature: measurement in a radiation shield
- Soil and water temperature: measurement with a waterproof sensor

## Data acquisition of capacitance probes

We offer the **IoT4H2O® devices** as data acquisition devices.



### Digital piercing thermometer

range -50 to +200 °C

switchable to °F

a nice-to-have for WM-HH

[Digital piercing thermometer](#)



### Sensor WM-BT-X

**for soil & water temperature**

for WM-Monitor, IoT & others

[Sensor for soil and water temperature](#)



### IoT-TRF Combi sensor

**for air temperature & rel. humidity**

Good & economic sensor in convection cap with wall mount for IoT4H2O & others

[IoT-TRF Combi sensory](#)



### Sensor for air temperature

Good & economic sensor in convection cap with wall mount for IoT4H2O & others

[NOS-LT Sensor for air temperature](#)



### NOS-NTTT Combi sensor

**for wet- & dry-bulb temperature**

accuracy:

±0.2 °C in the range 0 to 70°C

[NOS-NTTT Combination sensor](#)



### Sensor for Temperature

**under fleece and foil**

high accuracy 10kOhm NTC

for Frost Alert in early potatoes for IoT4H2O & others

[NOS-VT Temperature sensor i](#)

## IoT4H2O



### IoT4H2O® base unit with NB-IoT radio

The turnkey solution

[IoT4H2O® devices NB IoT](#)



### IoT4H2O® base unit with LoRAWAN radio

The solution for integrators and developers

[IoT4H2O® device LoRaWAN](#)

## WARNING SYSTEMS



### Temperature in asparagus comb

IoT4Spargel measures 40cm / 20cm / 5cm / 0cm under dam crown

Data provided by web-app (incl.)

[IoT4Spargel Temperature measurement i](#)



### Frost monitoring for tree fruit & for general frost protection tasks

Data provided by web-app (incl.)

[IoT4Frost Frost monitoring](#)



**Universal Data  
Aquisition System**



IoT4H2O® („IoT for water”) are small, low-cost data acquisition and transmission devices that communicate via LoRaWAN or NB IoT wireless standards and can be equipped with a wide variety of different sensors.

IoT stands for Internet of Things. IoT data acquisition systems transmit the acquired measurement values via radio and make the data available in the data cloud.

The IoT4H2O® devices thus enable both, the economic new construction of wireless data acquisition systems and the upgrade of existing sensors with wireless data transmission capabilities, thus bringing the company's own data acquisition to a new level.

Outdated handheld readers or data loggers without wireless data transmission can be replaced while continuing to use existing sensors. In this way, resources are saved.

The IoT4H2O® devices use the IoT narrow band standards LoRaWAN and NB IoT. These radio standards are characterized by

- extremely low power consumption
- low cost
- high range
- data security
- unprecedented penetration of obstacles

Therefore they are ideally adapted to the requirements of data acquisition in urban green, agriculture, horticulture and generally for outdoor applications.

## INFORMATIVE ARTICLES



**IoT4H2O® Basics & Background**  
about abilities, how it works, advantages of IoT4H2O® system

[About IoT4H2O®](#)



**IoT4H2O® Step-by-step**

Step by step guide to a ready-to-use IoT4H2O® system

[IoT4H2O® Steps](#)



**Sensors compatible with  
IoT4H2O®**

List of supported sensors for IoT4H2O® - is constantly extended

[IoT4H2O® compatible sensors](#)

## BASE UNITS



**IoT4H2O® base unit  
with NB-IoT radio**

The turnkey solution

sku: IOT-NB

[IoT4H2O® devices NB IoT](#)



**IoT4H2O® base unit  
with LoRAWAN radio**

The solution for integrators and developers. sku: IOT-LO

[IoT4H2O® device LoRaWAN](#)

## DATA RETRIEVAL



**Hosting & access to web app  
subscription per device/year**

for NB-IoT only !

[Hosting & access web app per device/year](#)



### Step 1

#### Which parameters should be measured?

##### Examples:

temperature, soil water potential, volumetric water content of the soil, relative humidity, radiation, water level...

### Step 2

#### How many sensors should be used?

##### Maximum possible per device:

- 6 sensors with resistance signal and 3 sensors with voltage signal (please note for sensors with voltage signal: some of these sensors use several inputs)  
or
- Up to 10 sensors with SDI-12 communication (Please note with SDI-12 sensors: Many SDI-12 sensors output more than one parameter. Up to 10 sensors, even with multiple parameters, can be connected)

### Step 3

#### How many measuring sites need to be covered? Are the sites to be measured close to each other or further apart?

If the measuring points are within a radius of approx. 10 m, one IoT4H2O® device may be sufficient. If the measuring sites are further apart, several IoT4H2O® devices should be used.



### Step 4

#### Which sensor type should be used?

Supported sensors - see list of supported sensors

[IoT4H2O® compatible sensors](#)

The list is constantly being expanded.

##### Examples:

- A. The temperature should be measured – which temperature exactly? (Air temperature, soil temperature, water temperature, wet bulb temperature...)
- B. The soil water potential should be measured – measurement with tensiometer or measurement with watermark sensor?
- C. The soil water content is to be measured – which sensor model should be used?

We would be happy to advise you on the compilation of sensors - [please contact us!](#)

### Step 5

#### How should the data be transferred?

Possible with NB IoT or with LoraWAN

##### IoT4H2O® devices with NB IoT radio

IoT4H2O® devices with NB IoT radio represent the turnkey solution and are particularly suitable for users who are looking for a **simple, universal and ready-to-use solution**. In most cases, the collected data are made available to users via a web app on our data cloud [www.IoT4water.de](http://www.IoT4water.de).

Our web app presents the data already prepared in the form of graphs and tables. Various additional functions are available, like setting of agronomic lines for crop-specific optimum. The web app [www.IoT4water.de](http://www.IoT4water.de) offers options for user, device and site management and the data can be downloaded to your own computer for permanent storage. Of course, all rights to the data remain with the respective owner of the IoT4H2O® device.

The IoT4H2O® web app can be used with both, a **smartphone and a computer**. On the smartphone it behaves like a conventional app, on the computer like a conventional website. It works on Android, iOS and Windows-based devices.

Startup an use of IoT4H2O® devices is extremely easy and can be done within 5 minutes, even by users with limited technical background.

For integrators and developers, it is also possible to retrieve data from IoT4H2O® devices with NB IoT radio at our API, or to forward the data to their own platform via UDP forward or HTTP callback. In the latter cases, the data are not stored and presented on our data cloud [www.ioT4water.de](http://www.ioT4water.de), but the user develops their own data interface. We provide a free Integrator Guide with a description of the payload for programming your own data interface. This approach is suitable for users who are able to program their own user interface or have it programmed.

### IoT4H2O® devices with LoRaWAN radio

IoT4H2O® devices with LoRaWAN radio are the preferred solution for integrators and developers, as well

as for advanced users who place the highest value on the protection of collected data or lowest cost. When using IoT4H2O® devices with LoRaWAN radio, it is possible to design the data acquisition system in such a way that the data never leaves the own network.

The data collected with IoT4H2O® devices with LoRaWAN radio can be stored and presented on our data cloud [www.ioT4water.de](http://www.ioT4water.de), but in most cases the user develops their own data interface.

We provide a free Integrator Guide with a description of the payload for programming your own data interface. With this information and the corresponding programming skills, a vast variety of different customer-specific data interfaces can be developed with virtually no limitations.

The version of the IoT4H2O® devices with LoRaWAN radio is ideal for integrators and developers, but can also be used as a turnkey solution at locations **where NB IoT network coverage is not yet available**.

However, this approach requires somewhat greater effort and therefore higher cost.

We would be happy to advise you on the selection of the transmission -[please contact us](#)!

## Step 6

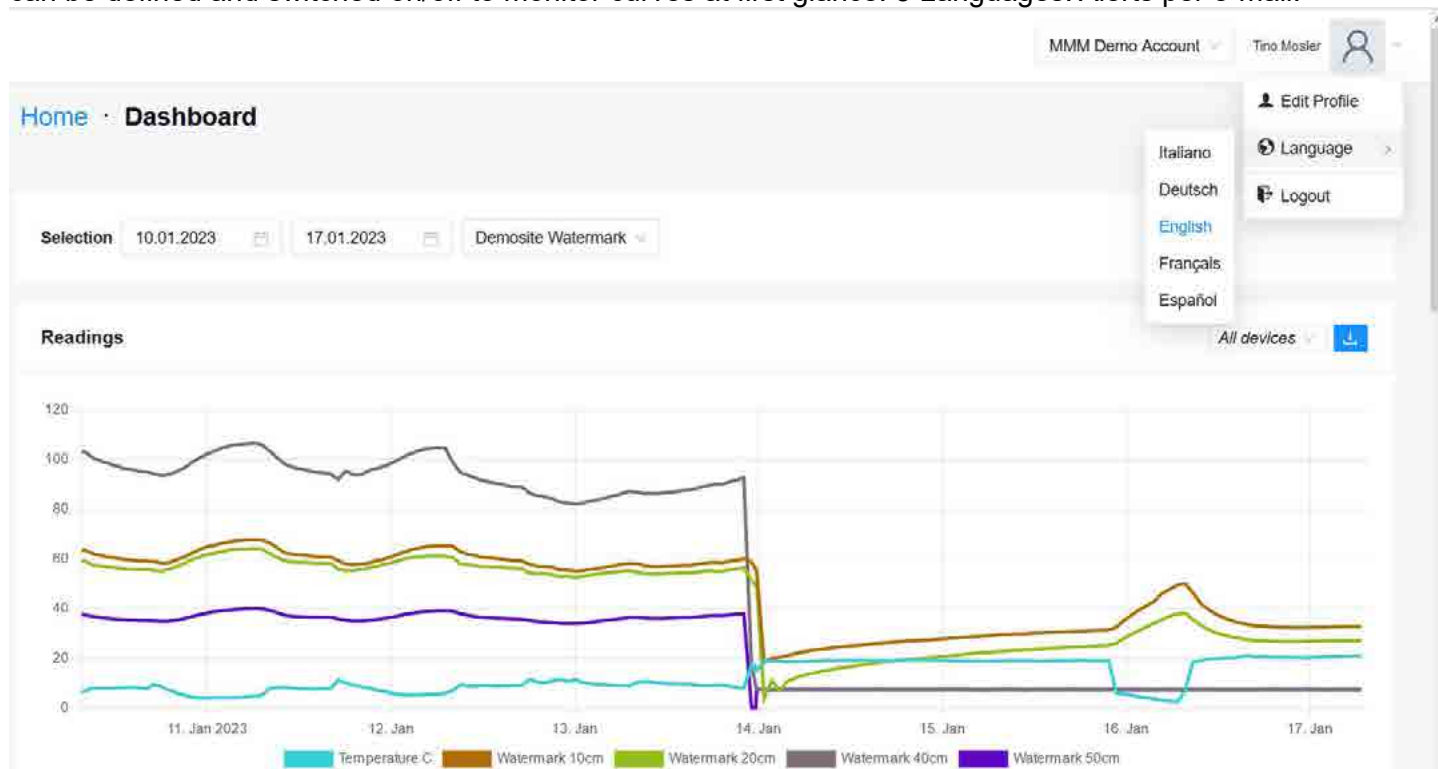
### How should the data be accessed?

Possible via our own WebApp [www.ioT4water.de](http://www.ioT4water.de) or via a user's own interface.

For further information on the possibilities of data access via an own user interface, see the section Properties IoT4H2O® or [contact us](#)

### WebApp IoT4H2O short description:

Data displayed in user's own account, sorted by sites, devices, sensors, as Lists and Curves, agronomic lines can be defined and switched on/off to monitor curves at first glance. 5 Languages. Alerts per e-mail.



An in-house weather station is used to obtain, record and provide general meteorological data and data on growing conditions. Accurate local weather data provide important information and a basis for decision-making for a wide range of possible applications and can identify opportunities for improvement and potential savings.

Weather stations with different sensor technology and with and without automatic remote data transmission are available.

## DOWNLOADS

about IoT4all

**IoT4Water Dateninterface Anleitung DE**

[Download](#)

**IoT4H2O-NB-II Anleitung DE**

[Download](#)

about Metos

**Pessl Catalogue 2025 EN**

[Download](#)

## DEVICES



### WatchDog Micro weather station

Micro weather station for various parameters from Spectrum

[WatchDog Micro Weather Station](#)



### IoT4all Weatherstation

Complete package for the acquisition of general meteorological data based on IOT-NB

[IoT4all Weatherstation](#)



### iMetos 3.3 weather station

High-end weather stations with maximum flexibility

[iMetos 3.3 weather station](#)



### Metos 5 weather station

High-end weather stations with maximum flexibility  
extended connectivity

[Metos 5 weather station](#)

## WATCHDOG SENSORS



### Temperature sensor WD-TEMP

for WatchDog  
temperature in ground, water

[WD-Temp Temperature sensor \(ground, water\)](#)



### WD-Rain Sensor for precipitation

for WatchDog  
accuracy  $\pm 2\%$  Precipitation  
cable 2m

[WD-Rain Sensor for precipitation](#)



### WD-BLN Sensor for leaf wetness

for WatchDog  
Range 0 (dry) to 15 (wet)  
cable 2m

[WD-BLN Sensor for leaf wetness](#)

**Further Sensors for WatchDog** can be found in Chapters **Capacitance** and **Radiation**.

## METOS SENSORS & EXTENTIONS



### Sensors for Metos

A selection of Sensors for Metos weather stations

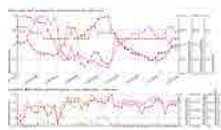
[Sensors for Metos](#)



### Prediction models for plant diseases and pests

Available for numerous crops for Metos stations

[Prediction plant diseases and pests](#)



### Location-specific weather forecast

Highly accurate, site-specific weather forecast for Metos stations

[Location-specific weather forecast](#)



## Crop production special crops

- [Cultivation in tunnel and greenhouse](#)
- [Vegetable growing in open field](#)
- [Softfruit production in open field](#)
- [Fruit tree](#)
- [Asparagus cultivation](#)
- [Herbs, spices and aromatic plants](#)
- [Ornamental plants](#)
- [Tree and vine nursery](#)
- [Viticulture](#)



## Crop production arable farming

- [Irrigation farming](#)
- [Dry land farming](#)

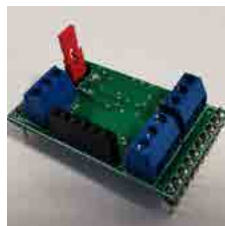


## Water- & Landfill management

- [Water management](#)
- [Landfill](#)



## Research

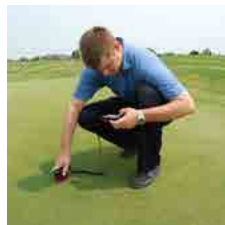


## IoT integrator & developer



## Urban green

- [Urban green](#)
- [Lawn & Landscape](#)



## Golf & sports field

- [Golf](#)
- [Sports field](#)



Suction Lysimeter are used to collect soil water or soil solution for analysis purposes. Suction Lysimeter can be used in mineral soils as well as in substrates without any problems.

Soil solution obtained with Suction Lysimeter can be analyzed for numerous questions: content and possible deep percolation of nutrients, salts and also pollutants in the soil solution.

## Advantages

The analysis of the soil water allows conclusions to be drawn about the availability of nutrients and the salt concentration in the soil solution.

Concentration gradients of nutrients and salts in the soil can be traced using Suction Lysimeter installed at different depths in the soil.

## Functionality

To remove soil water, a negative pressure is generated inside the suction lysimeter with a vacuum pump, and the penetrating soil water is then collected for analysis.

## Typical fields of application

Extraction of soil solution in all cultures and investigations.

## LYSIMETER MODELS



### MMM Suction Lysimeter - model Lys

Economical Suction Lysimeter  
lengths: 20, 30, 50, 60, 90 cm

[Suction Lysimeter - Lys](#)



### MMM Suction Lysimeter - model A-Lys

High-end Suction Lysimeter with ceramic made of aluminum oxide material; 20, 30, 50, 60, 90 cm

[Suction Lysimeter- model A-Lys](#)



### Irrrometer® Suction Lysimeter

**IR-Lys** Suction Lysimeter of the well-known high Irrrometer standard.

length: 15, 30, 45, 60, 90 cm

[Irrrometer® Suction Lysimeter](#)



### Irrrometer® Suction Lysimeter low-tension

**IR-LYS-LT**, especially for substrates,  
length: 15, 30, 45, 60, 90 cm

[Irrrometer® low-tension Lysimeter](#)

## SPARE PARTS & ACCESSORIES



### Lys-SH syringe

Syringe 100ml with Luer connection as a vacuum pump, negative pressure of approx. -600 mbar

[Lys-SH syringe](#)



### IR-Lys-P hand vacuum pump

Hand vacuum pump with pressure gauge

[IR-Lys-P hand vacuum pump](#)



### LYS-V closure

Closure, hose and hose clamp for MMM Lysimeter

[LYS-V closure](#)



### IR-Lys-V closure

Closure, hose and hose clamp for Irrrometer Lysimeter

[IR-Lys-V closure](#)



### IR-Lys-VDBL closure

Closure, 2 suction hoses with 2-way stopcock, Luer

[IR-Lys-VDBL closure](#)



### Lys-S syringe

Syringe for sampling soil solution

[Lys-S syringe](#)



### Hose Clamp Lys-K

Quetsch-Fix hose clamp for MMM-Lysimeters

[Lys-K Quetsch-Fix](#)



### 3 way Luer connector

3 way Luer connector for suction lysimeter

[LYS-3HAHN](#)

A timely analysis of the content of nutrients and pollutants is of great importance in many areas of application. In crop production, knowledge of the content of existing plant nutrients is the basis of any professional fertilizer application.

**Different approaches are common:**

## Soil analysis:

Here, solid soil or substrate samples are prepared for analysis by slurrying with distilled water or extraction solutions and analyzed for nutrient content.

## Analysis of soil solution:

Here, soil solution is obtained with suction lysimeters, and analyzed for nutrient content.

## Analysis of press-sap of different plant organs:

Here, the sap of fresh plant organs (petioles, fruits, etc.) is pressed out and used for analysis.

[More information Press-Sap Analysis on our Youtube channel.](#)

## Water analysis:

Here, water or fertigation solution is analyzed directly for ion content.

We offer a wide range of fast on-site analysis instruments for many applications.

**HORIBA**  
**LAQUA**



## DEVICES

### Ion Selective Pocket Meter Laqua Twin from Horiba



Ion-selective pocket meters for nitrate, potash, calcium, sodium/salt, and fluoride

[Laqua Twin Pocket Meters](#)

### Complete Set of Laqua Twins



Practical set of 4, 6, or 7 ion selective Laqua twin pocket meters from Horiba.

[Laqua Twin meters as Complete Set](#)

### NutriLab WebApp



App for the interpretation of measured values of the plant press-sap analysis

[NutriLab WebApp](#)

### High quality ion selective benchtop meter from Japan



LAQUA ION2000 Benchtop Meter for Ion Concentration, pH and ORP

[LAQUA ION2000 Benchtop Meter](#)



## ACCESSORIES



### Calibration Solution Set

Calibration Solution Set for

K, Na, Ca, F, ORP

[Calibration Solution Set](#)



### NO3 Calibration solution

diverse standards up to 5000 mg/l

[NO3 Calibration solution](#)



### Stainless steel press

Stainless steel press for leaf stem press juice extraction

[Stainless steel press](#)

## SPARE PARTS

### Replacement sensor Laqua Twin



for Laqua Twin pocket meters; nitrate, potash, calcium, sodium and salt, fluoride and ORP

[Exchange sensor](#)



**Ion selective combination electrode for NO3 or K / Ca / F with BNC connector**

[Ion selective combination electrode](#)

The pH value is a central value in many areas of application: Chemistry, agriculture, horticulture, aquaculture, aquariums, water treatment, wastewater treatment, healthcare, food industry and art restoration to name but a few.

In agriculture and horticulture, the pH value of soil and substrates is a central parameter for the growth conditions in the root zone, and has a considerable influence on plant nutrition, growth and plant health.

Nutrient availability for and nutrient uptake by plants are also determined by the pH value of the soil: At low pH, the availability of nitrogen, phosphorus, potash, calcium, magnesium and molybdenum is limited; at high pH, nitrogen, calcium, magnesium, iron, manganese, copper and zinc are poorly available. Therefore, quick, easy and accurate measurements of pH are important. pH is also an important parameter for evaluating water for aquaculture and irrigation purposes. Another important agricultural application is the measurement of the pH value of spray liquids.

## HORIBA LAQUA

### BENCHTOP



#### pH benchtop meter Laqua PH1500

Good value for money, ideal for routine applications

LAQUA-PH1500-SS:  
electrode 9651-10D, sealed

LAQUA-PH1500-SR  
electrode 9625-10D, refillable

[pH value table meter LAQUA PH1500](#)



#### pH benchtopmeter Laqua PH2000

state-of-the-art, user-friendly and GLP-compliant device

PH2000-SR  
electrode 9625-10D, refillable

Different electrodes available

[pH value table meter LAQUA PH2000](#)



#### pH benchtop meter Laqua F-72A-S

Measuring device with touchscreen color display for stress-free work

[pH table meter LAQUA F-72A-S](#)

### HANDMETER



#### PH-TM2 pocket meter

splash-proof pocket meter for pH and temperature in liquids, incl. PH-KL7, PH-KL

[PH-TM2](#)



#### Laqua Twin pH Pocket meters

waterproof pocket meter for pH value for smallest sample volume diff. models for 2, 3 or 5 point cal.

[Laqua Twin Pocket meters](#)



#### Laqua Twin ORP Pocket meter

Laqua Twin Oxidation-reduction potential (ORP) Pocket Meter

[Laqua Twin ORP Pocket Meter](#)

ISFET pocket meters

#### Pocket meter with ISFET sensor

waterproof, resolution

pH-712: 0.1 pH / 0.1 °C

pH-922: 0.01 pH / 0.1 °C

[pH pocket meter with ISFET sensor](#)



#### pH handheld meter PH-MM1

waterproof, data memory. PH-MM1P

with optional piercing electrode

[pH Handheld meter model PH-MM1](#)



#### Laqua handheld pH meters

Top class handheld from Japan

PH210 500 records

PH220 1000 rec., data print & export

[Handheld pH meters Laqua](#)



#### Handheld pH meter model Laqua WQ310-PH-K

Laqua WQ300 - modular, intelligent, digital handheld water quality meter

[Laqua WQ310-PH-K](#)

## 3 IN 1 ELECTRODES, PLASTIC

**9652-10D for field tests**

3-in-1 pH electrode with plastic body

[9652-10D for field tests](#)**9651-10D for field tests**

3-in-1 pH electrode with plastic body

[9651-10D for field tests](#)**9625-10D for universal use**

3-in-1 pH electrode with plastic body

[9625-10D for universal use](#)**9630-10D for samples with  
low conductivity**

3-in-1 pH electrode with plastic body

[9630-10D samples ow conductivity](#)**9631-10D for hydrofluoric acid or  
HF samples**

3-in-1 pH electrode with plastic body

[9631-10D for hydrofluoric acid ...](#)**9632-10D for strongly alkaline  
samples**

3-in-1 pH electrode with plastic body

[9632-10D for strongly alkaline samples](#)

## 3 IN 1 ELECTRODES, GLASS

**9615S-10D Standard****ToupH electrode**

for general laboratory applications

3-in-1 glass pH electrode

[9615S-10D Standard ToupH](#)**9680S-10D Long ToupH electrode**

for large vessels and long tubes

3-in-1 glass pH electrode

[9680S-10D Long ToupH](#)**9618S-10D Micro ToupH electrode**

for low volume samples

3-in-1 glass pH electrode

[9618S-10D Micro ToupH](#)**9681S-10D -ToupH electrode with  
sliding diaphragm**

for viscous and non-aqueous

samples 3-in-1 glass pH electrode

[9681S-10D -ToupH electrode](#)**6367-10D - High precision**

for high-precision pH measurement

3-in-1 glass pH electrode

[6367-10D high-precision pH measurement](#)**6252-10D for food samples**

3-in-1 glass pH electrode

[6252-10D or food](#)

## ISFET ELECTRODE

**0040-10D ISFET pH electrode**

pH electrode, replacable sensor

[ISFET pH electrode](#)

## COMBI ELECTRODES GLASS

**9415-10C Standard ToupH electrode**for general laboratory applications  
pH combi electrode with glass body[9415-10C Standard ToupH electrode](#)**9418-10C Micro ToupH electrode**

for low volume samples

pH combi electrode with glass body

[9418-10C Micro ToupH electrode](#)

## COMBI ELECTRODE PLASTIC

**9425-10C pH electrode****for universal use**Refillable pH electrode plastic body,  
waterproof, 1m cable[9425-10C for universal use](#)**9481-10C ToupH electrode**for viscous and non-aqueous  
samples

pH combi electrode with glass body

[9481-10C ToupH electrode](#)**6069-10C refillable pH electrode**

for very slim test tubes

pH combi electrode with glass body

[6069-10C for very slim test tubes](#)**9480-10C Long ToupH electrode**for large containers and long test  
tubes

pH combi electrode with glass body

[9480-10C Long ToupH electrode](#)**6261-10C flat pH electrode**

for measuring flat surfaces

pH combi electrode with glass body

[6261-10C flat tip](#)**6452-10C piercing pH electrode**

for food samples

pH combi electrode with glass body

[6452-10C piercing tip](#)

## BUFFERS


**Liquid pH calibration buffers  
ready for immediate use**

20 ml foil bag: PH-KL4 - pH 4,0  
PH-KL7 - pH 7,0  
PH-KL10 - pH 10,0

250 ml bottle:  
PH-KL4-250 pH 4,01  
PH-KL7-250 pH 7,00  
PH-KL10-250 pH 10,01

[Liquid pH calibration buffers](#)


**PHP powder pads ...**

can be shipped inexpensively, have a longer shelf life - save resources.

pH powder to dissolve in 50ml:

PHP-04 pH 4,01(red)  
PHP-07 pH 7,00(yellow)  
PHP-10 pH 10,01(blue)

[Instant powder for color coded standards](#)


**PH Calibration Solution Set**

SKU: LA-pH-KLKIT

Calibration pH4 & pH7  
in 2 bottles ( 14 ml)  
[PH Calibration Solution Set \(pH4 & pH7\)](#)


**PE bottle with dropper tip**

SKU: PH-TF

empty bottle capacity 50ml

[PE bottle with dropper tip, 50ml](#)

## SPARE PARTS &amp; ACCESSORIES


**Exchange pH electrode  
PH-TM2-S**

for PH-TM2 pocket meter

[Exchange pH electrode for PH-TM2](#)


**300PH-2 pH sensor head**

for Laqua WQ300 series  
cable 2 m

[300PH-2 pH sensor head](#)


**Exchange pH electrode  
LA-PH-S**

for Laqua Twin Pocket meter

[pH electrode Laqua Twin](#)


**300PH-5 pH sensor head**

for Laqua WQ300 series  
cable 5 m

[300PH-5 pH sensor head](#)


**Exchange ORP electrode  
SKU: LA-ORP-S**

for Laqua Twin Pocket meter

[ORP electrode Laqua Twin](#)


**Adapter for conventional BNC  
electrodes to sensor head**

SKU: 3200821465

for Laqua WQ300 series

[Adapter BNC electrode to sensor head](#)


**ISFET Replacement tip  
SKU: 141**

for ISFET pH Electrode (0040-10D)

[Replacement tip for ISFET pH electrode](#)


**300-PH-C-2 pH sensor cartridge**

SKU: 3200786363

for Laqua WQ300 series

[300-P-C pH sensor cartridge](#)


**Replacement Reference Electrode**

PH-ARE

for Laqua PH devices PH-712 and  
PH-922

[Electrode for PH-712 & PH-922](#)

The EC value or the conductivity of the soil solution and in soil extracts is an expression of the salinity of the soil solution.

The EC value is therefore an important parameter for the growth conditions in the root area and has a significant influence on the growth and health of the plants. The simplest way to measure soil salinity is to measure the soil's electrical conductivity (EC value).

The EC value is closely correlated with the salinity of the soil solution and is also influenced by temperature and soil moisture.

Temperature compensation is therefore always necessary when measuring the EC value. A direct measurement in the soil or substrate should always be carried out at a soil moisture level close to field capacity.

The EC value is also an important parameter for assessing water for irrigation purposes. Many plant species can be harmed by a too high EC value of the irrigation water.

Controlling fertilizer solutions (and stock solution) for fertigation in protected and open fields is another important application. During fertigation, the EC value should be checked regularly to ensure that all plants are receiving sufficient nutrients, but also that salt levels are not building up too much.

**HORIBA**  
**LAQUA**



## DEVICES



### EC value pocket meter EC-TM2

splash-proof pocket meter for EC, TDS and temperature in liquids, electrode exchangeable.

[EC value pocket meter EC-TM2](#)



### Laqua Twin EC pocket meters

High end waterproof pocket meter for EC for the smallest sample volumes

Models for diff. measuring ranges.

[EC value pocket meters Laqua Twin](#)



### EC measuring device FSEC 20

Fieldscout EC meter for EC measurements directly in the substrate and soil, sensor 20 cm.

[EC measuring device FSEC 20](#)



### EC-MM1 Handheld meter

Waterproof hand-held measuring device with internal data memory

[EC-MM1 Handheld meter](#)



### Laqua handheld EC meters

Top class handheld from Japan

EC210 500 records

EC220 1000 rec., data print & export

[Laqua EC210 & EC220](#)



### Handheld EC meter model Laqua WQ310-EC-K

Laqua WQ300 - modular, intelligent, digital handheld water quality meter

[Laqua WQ310-EC-K](#)

## CONDUCTIVITY MEASURING CELLS AND EC SENSORS

**9383-10D conductivity cell**

For universal use, waterproof / submersible type  
for WQ310-EC-K & others

[9383-10D conductivity cell](#)

**9382-10D conductivity cell**

For universal use, waterproof / submersible type

[9382-10D conductivity cell](#)

**3551-10D conductivity cell**

For low conductivity water, immersion type, glass body

[3551-10D conductivity cell](#)

**3552-10D conductivity cell**

For universal use, immersion type, glass body,

[3552-10D conductivity cell](#)

**3553-10D conductivity cell**

For water with high conductivity, immersion type, glass body

[3553-10D conductivity cell](#)

**9371-10D conductivity cell**

For ultrapure water / low conductivity measurements, stainless steel.

[9371-10D conductivity cell](#)

**3561-10D conductivity cell  
flow - measuring cell**

For low conductivity water, glass body

[3561-10D conductivity](#)

**3562-10D conductivity cell  
flow - measuring cell**

For universal use, glass body

[3562-10D conductivity](#)

**3573-10C conductivity cell  
flow - measuring cell**

For water with high conductivity, glass body

[3573-10C conductivity cell](#)

**3574-10C conductivity cell  
flow - measuring cell**

For column chromatography with very small (0,25 ml) sample amount, glass body

[3574-10C conductivity](#)

## BUFFER

**Liquid EC calibration buffers  
ready for immediate use**

20 ml foil bag:

EC-KL1413 - 1,413 mS/cm  
EC-KL1288 - 12,88 mS/cm

250 ml bottle:

EC-KL1413-250 - 1,413 uS/cm  
EC-KL1288-250 - 12,88 mS/cm  
EC-KL1118-250 - 111,8 mS/cm

FSEC-KL278 - 2,78 mS/cm  
(for FSEC 20 device)

[EC calibration buffers](#)

**EC Calibration Solution Set**

Calibration 1,413 & 12,88 mS/cm  
in 2 bottles ( 14 ml)

SKU: LA-EC-KLKIT

[EC Calibration Solution Set](#)

## SPARE PARTS



**Exchange EC electrode**  
**EC-TM2-S**  
for EC-TM2 pocket meter

[EC-TM-S electrode](#)



**Exchange EC electrode**  
**LA-EC-S**  
for Laqua Twin Pocket meter

[EC electrode Laqua Twin](#)



**Exchange EC sensor FSEC-P20**  
Piercing sensor 20 cm  
for Fieldscout EC device FSEC-20

[Piercing sensor Fieldscout EC](#)



**300-C EC/TDS/RES/SAL head**  
for Laqua WQ300 series,  
WQ310-EC-K  
SKU: 3200784468 - cable 2m  
3200812202 - cable 5m

[300-C EC/TDS/RES/SAL head](#)



**Conductivity sensor cartridge**  
**300-4C-C**  
for Laqua WQ300 series,  
WQ310-EC-K  
SKU: 3200780928

[300-4C Conductivity sensor cartridge](#)

## DOWNLOADS

**Downloads LAQUA-TWIN-EC**

LaquaTwin EC-11-22-33 Manual EN [Download](#)

LaquaTwin Pocket Water Quality Meters Brochure EN [Download](#)

**Downloads FSEC-20**

2266FS-2266FSTP Meter Manual EN [Download](#)

**Downloads EC210 & EC220**

Laqua EC210-220 Manual EN [Download](#)

Laqua 200-Series Brochure EN [Download](#)

Laqua 200-Series Quick Guide EN [Download](#)

**Downloads WQ310-EC-K**

Laqua 300 Series Conductivity Quick Guide EN [Download](#)

Laqua 300 Anleitung DE [Download](#)

Laqua 300 Direcciones ES [Download](#)

Laqua 300 Indicazioni IT [Download](#)

Laqua 300 Instruções PT [Download](#)

Laqua 300 Manual EN [Download](#)

Laqua 300 Manuel FR [Download](#)

Laqua WQ300 Smart Meters Brochure EN [Download](#)

**Download about Cells in this chapter**

Laqua Electrodes & Accessories EN [Download](#)

The measurement of dissolved oxygen (DO) is an important parameter in many applications:

- water analysis
- aquaculture
- aquaristics
- wastewater treatment
- beverage production, especially:  
wine  
beer.

We offer dissolved oxygen meters from the Japanese manufacturer Horiba with galvanic and optical probes.



## DEVICES



### Laqua DO210

Handheld dissolved oxygen meter with galvanic probe, carrying case  
SKU: DO210-K

[Laqua DO210](#)



### Laqua DO220

GLP compliant handheld dissolved oxygen meter with galvanic probe. with carrying case.

SKU: DO220-K

[Laqua DO220](#)



### Laqua WQ310-DO-K

Modular, intelligent, digital handheld meter with optical sensor for dissolved oxygen with carrying case

SKU: WQ310-DO-K

[Laqua WQ310-DO-K](#)

## SPARE PARTS AND ACCESSORIES



**Galvanic DO probe 9552-20D / -50D**  
with integrated temp. sensor.

for: DO210, DO220 devices

SKU: 3200780939

[Galvanic DO probe 9552-20D / -50D](#)



### Exchange DO tip

Exchange DO tip for probe 9552-20D / -50D for DO210, DO220 devices. SKU: 3200780939

[Exchange DO tip](#)



### 300-D Optical DO sensor incl. Cap

DO Sensor incl. 1 DO membrane cap. SKU: 3200780940

for: DO210, DO220 and WQ310-DO

[300-D Optical DO sensor incl. Cap](#)

## DOWNLOADS



### Downloads DO210-K

Laqua PD201-220 Manual EN [Download](#)

Laqua 200-Series Brochure EN [Download](#)

Laqua 200-Series Quick Guide EN [Download](#)



### Downloads DO220-K

Laqua PD201-220 Manual EN [Download](#)

Laqua 200-Series Brochure EN [Download](#)

Laqua 200-Series Quick Guide EN [Download](#)



### Downloads WQ310-DO-K

Laqua 300 Series DO Quick Guide EN [Download](#)

Laqua WQ300 Smart Meters Brochure EN [Download](#)

Laqua 300 Manual EN [Download](#)

In this chapter electrochemical measuring instruments that can measure several characteristic values are covered.

Our product range includes handheld instruments for outdoor use and benchtop instruments for the laboratory.

The parameters pH, conductivity / EC value, dissolved oxygen / DO, ions, turbidity and more are covered.



## Downloads PC210 & PC220

Laqua PH210-220 Manual EN [Download](#)

Laqua PD201-220 Manual EN [Download](#)

Laqua EC210-220 Manual EN [Download](#)



## Downloads PD200-K

Laqua PH210-220 Manual EN [Download](#)

Laqua PD201-220 Manual EN [Download](#)

Laqua EC210-220 Manual EN [Download](#)



## Downloads WQ300-K

Laqua 300 Indicazioni IT [Download](#)

Laqua 300 Direcciones ES [Download](#)

Laqua WQ300 Smart Meters Brochure EN [Download](#)

Laqua 300 Anleitung DE [Download](#)

Laqua 300 Manual EN [Download](#)

Laqua 300 Manuel FR [Download](#)

Laqua 300 Instruções PT [Download](#)



## Downloads U-50

U-50-Series Info sheet EN [Download](#)



## Downloads PC1500-SR

Laqua 1500-Series Brochure EN [Download](#)



## Downloads PC2000-SR

Laqua 2000-Series Brochure EN [Download](#)



## Downloads F-73A-S

Laqua Electrodes & Accessories [Download](#)

Laqua F-Series benchtop meters with color touchscreen Brochure EN [Download](#)

## HAND METER



### Laqua PC210 & PC220

Dual channel handheld meter Laqua PC210 & PC220 for pH/ORP/EC/TDS/Salinity

[Laqua PC210 & PC220](#)



### Laqua PD210 & PD220

Dual channel handheld meter Laqua PD210 & PD220 for pH/ORP/DO

[Laqua PD210 & PD220](#)



### Laqua WQ300 series

Multi-parameter handheld meters Laqua WQ300 series with 2 or 3 channels

[Laqua WQ300 series](#)



### Horiba U-50 Series

Horiba U-50 Series Multiparameter Water Quality Meter  
- various types -

[Horiba U-50 Series](#)

## BENCHTOPS



### 2-channel bench meter

#### LAQUA PC1500-SR

for pH / ORP / conductivity / resistivity / TDS / salinity

[LAQUA PC1500-SR](#)



### 2-channel bench meter

#### LAQUA PC2000-SR

for pH / ORP / Ion / Conductivity / Resistivity / TDS / Salinity / Temp.

[LAQUA PC2000-SR](#)



### 2-channel bench meter

#### LAQUA F-73A-S

for pH / ORP / Ions

[LAQUA F-73A-S](#)



### 2-channel bench meter

#### LAQUA F-74-S

for pH/ORP/Ion/Temp/Conductivity/Resistivity/Salinity/TDS

[LAQUA F-74-S](#)

## SOIL DENSITY

## SPARE PARTS



### Soil probe BS-100

for sensing compacted layers in soil and subsoil, length 110 cm, OD 8 mm stainless.

[Soil probe BS-100](#)



### Soil Probe AG-BS-70

Soil Probe with indication of penetration resistance. Tips replaceable; types light or heavy soil.

[Soil Probe AG-BS-70](#)

### Replacement tip for AG-BS-70

|          |                                   |
|----------|-----------------------------------|
| AG-BS-SK | Tip for heavy soil, 13mm diameter |
| AG-BS-SG | Tip for light soil, 19mm diameter |

## SOIL SAMPLING & INSTALLATION OF SENSORS IN SOIL



### Drill rod IW-60

Lightweight drill rod for sensor installation and soil sampling in loose soils without stones. Depth 60cm

[Drill rod IW-60](#)



### Simplex sledge hammer

Simplex sledge hammer, 5.3kg, handle 100 cm.

for PKH soil sampler

[Simplex sledge hammer](#)

### Pürckhauer soil sampler

Available for 60cm, 90cm, 100cm max. penetration depth.

SKU: PKH-60, PKH-90, PKH-100

[Pürckhauer soil sampler](#)



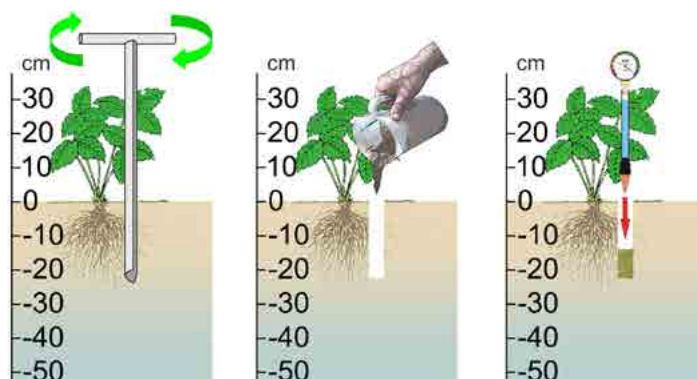
### Soil Drill

for snug-fit installation of Aquachecks

S-D-32-80 - 80cm

S-D-32-100 -100cm

[Soil Drill](#)



## General Terms and Conditions (Status : 17.06.2026)

The sale and delivery of our products are governed exclusively by our General Terms and Conditions, as amended from time to time. They are available at: <https://mmm-tech.de/en/legal/terms>

Es gelten ausschließlich unsere Allgemeinen Geschäftsbedingungen in der jeweils gültigen Fassung. Diese sind abrufbar unter: <https://mmm-tech.de/de/legal/terms>

Please check also our youtube channel, Link: <https://www.youtube.com/@MMMtechsupport/>



### MMM tech support



@MMMtechsupport • 378 Abonnenten • 31 Videos

Welcome to MMM Tech Support ...mehr

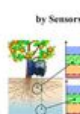
[mmm-tech.de/en](https://mmm-tech.de/en) und 1 weiterer Link

Abonnieren

Übersicht Videos Playlists

#### general information ▶ Alle abspielen

sensors, instructions and information



**Professional Irrigation Management by Sensors** - ...  
MMM tech support  
585 Aufrufe • vor 6 Jahren



**IoT4H2O - Universal Data acquisition System by MMM**  
MMM tech support  
365 Aufrufe • vor 4 Jahren



**Fieldscout Direct Soil EC Meter operation - by MMM** ...  
MMM tech support  
1365 Aufrufe • vor 12 Jahren



**Fieldscout TDR-100 operation - by MMM tech** ...  
MMM tech support  
7493 Aufrufe • vor 12 Jahren



**Decagon 10HS sensor installation - by MMM tech** ...  
MMM tech support  
1923 Aufrufe • vor 12 Jahren



**PMS Scholander chamber operation - by MMM tech** ...  
MMM tech support  
6783 Aufrufe • vor 12 Jahren

#### Nutrient Analysis ▶ Alle abspielen

Horiba Laqua pocket meters with Ion-selective Electrode are available for measurement of Nitrate, Potassium, Calcium, Sodium and Salt. Laqua pocket meters offer important benefits:For...



**Calibration of ion-selective Laqua-Twin Instruments**  
MMM tech support  
169 Aufrufe • vor 4 Jahren



**Horiba Laqua 4 Meter Kit presentation - English**  
MMM tech support  
68 Aufrufe • vor 5 Jahren



**Horiba Laqua 4 Meter Kit Präsentation - German**  
MMM tech support  
48 Aufrufe • vor 5 Jahren



**Präsentation Horiba Laqua Geräte (Deutsch)**  
MMM tech support  
158 Aufrufe • vor 5 Jahren



**Measurement of pH, EC and nutrients in horticulture by ...**  
MMM tech support  
506 Aufrufe • vor 5 Jahren



**Horiba Laqua Twin Nitrate Meter in action - by MMM** ...  
MMM tech support  
898 Aufrufe • vor 5 Jahren

#### Irrrometer Tensiometer ▶ Alle abspielen

Tensiometers manufactured by Irrrometer® meet highest expectations and have been continuously optimized for more than 50 years. The Irrrometer Tensiometers of the new generation are equippe...



**Irrrometer tensiometer portable - by MMM tech** ...  
MMM tech support  
14.003 Aufrufe • vor 12 Jahren



**Irrrometer mini-tensiometer installation - by MMM tech** ...  
MMM tech support  
1868 Aufrufe • vor 12 Jahren



**Irrrometer tensiometer LT (low tension) installation - by ...**  
MMM tech support  
4494 Aufrufe • vor 12 Jahren



**Irrrometer Tensiometer installation - by MMM tech** ...  
MMM tech support  
11.016 Aufrufe • vor 12 Jahren



**Damage free Tensiometer removal from field**  
MMM tech support  
250 Aufrufe • vor 3 Jahren

MMM tech support GmbH & Co. KG, Weigandufer 18, 12059 Berlin, Germany / [www.mmm-tech.de](http://www.mmm-tech.de)  
Amtsgericht Charlottenburg, HRA 47522 B // HRB 145663 B, VAT DE285644197



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