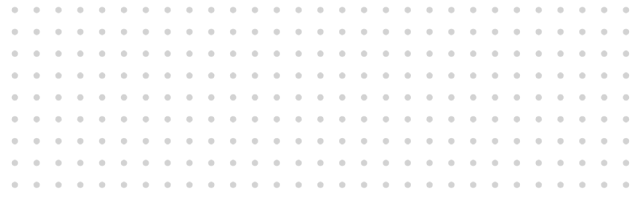




VisiSens™ – 2D Mapping of Oxygen, pH & CO₂



- 2D read-out of luminescent sensor foils
- Contactless direct sensing or through transparent walls
- Visualize spatial and temporal analyte gradients
- Numerous measurement points in one image



O₂

pH

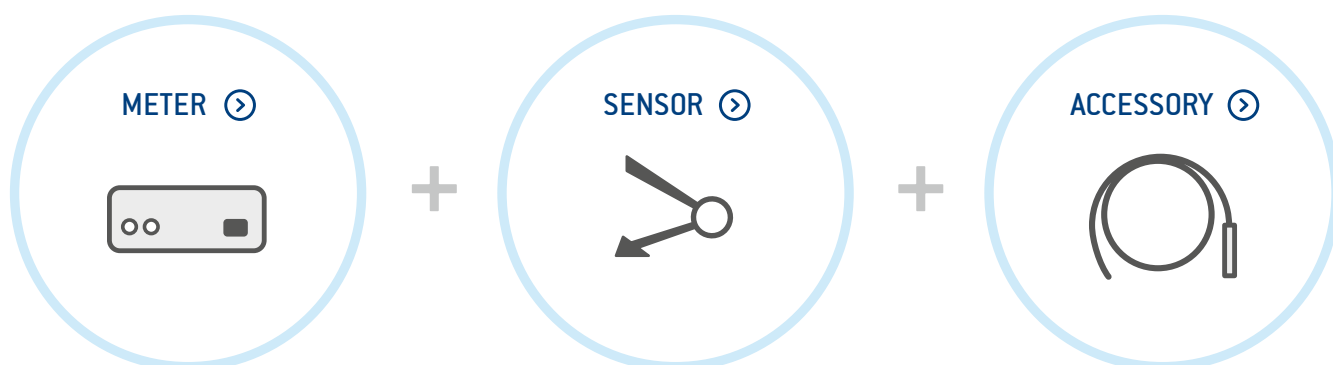
CO₂



Content

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- 05 Industries
- 06 VisiSens™ – 2D Mapping Solutions for O₂, pH or CO₂
- 10 VisiSens™ TD – Modular O₂, pH and CO₂ Mapping System
- 14 Product Matrix
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Functional Principle



We bring to light what's inside...



Products Made in Germany

PreSens offers a broad range of sensor systems for end users in Bioprocess Control, Biological & Environmental Research, the Food & Beverage industry as well as other industrial applications.

We offer systems for

- Oxygen measurement in gases and liquids
- Non-invasive online pH, CO₂ and oxygen measurement
- Oxygen and pH sensors for single-use bioreactors
- Microsensors pH, oxygen and CO₂
- Process control in shake flasks incl. biomass monitoring
- Low-maintenance DO measurement for fermentation and bioreactor systems
- Online oxygen and pH measurement in disposables like multiwell plates and plastic bags
- Imaging solutions for 2D-mapping of oxygen-, pH-, and CO₂-distribution

Our product range is constantly expanding.

Company Profile

Based on research activities started in the 1980's PreSens Precision Sensing GmbH was founded in 1997 as a spin-off from the University of Regensburg, Germany.

The company combines long-time experiences of different researchers in the fields of electronic engineering and sensor development. Right from the beginning, microsensor systems were sold to customers in life sciences. Already in its first decade of operation PreSens became one of the leading companies in the field of chemical optical sensor technology. Together with its partners it offers full service in Europe, America and Asia.

Service

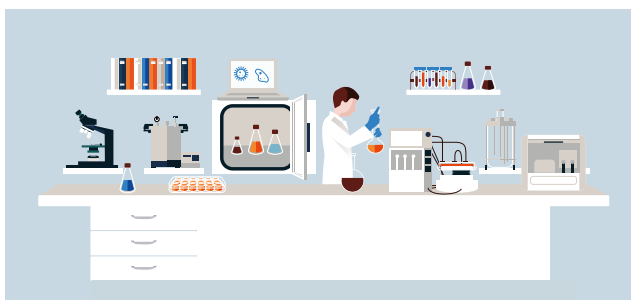
Furthermore, we are developers and manufacturers of optoelectronic OEM sensor components for companies in the field of medical equipment and process control.



Quality Management
ISO 9001
ISO 13485
Voluntary participation in regular monitoring

Is your application missing? Contact us and we find your customized solution!

...and work for the following industries.



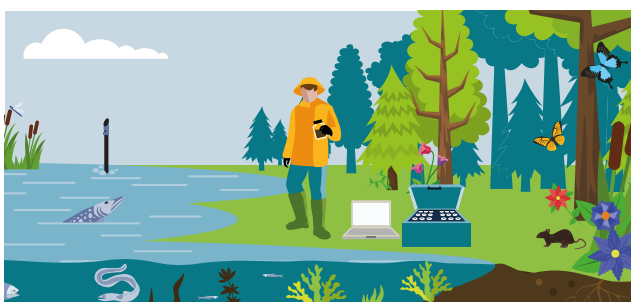
Biotech & Pharma

Our Biotech & Pharma business field helps pharmaceutical companies such as Roche and DSM to improve their bioprocess development with PreSens sensors. With two decades of customer feedback our product development provides efficient solutions for your needs.



Food & Beverage

A cooperation with the market leader for beverage filling systems, Kronen AG, Neutraubling, triggered our Food & Beverage business field in the late 1990's. PreSens supplies sensors for checking the oxygen-tightness of packaging and special systems for determining the penetrability of oxygen in PET bottles at companies such as Nestlé, Heineken or Danisco.



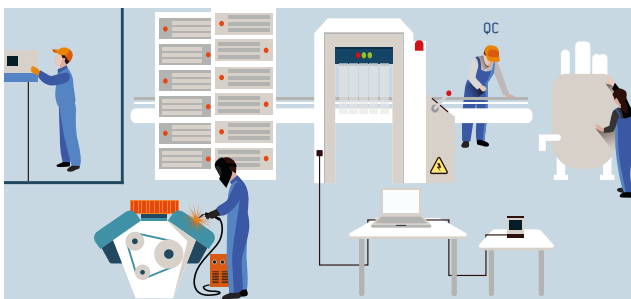
Biology & Environmental

Our worldwide customer base in biological & environmental research has now grown to hundreds of users coming from the University of Alaska in Anchorage to the University of Wellington in New Zealand. For more than two decades we have delivered special sensor systems for various applications such as respirometry, or environmental monitoring.



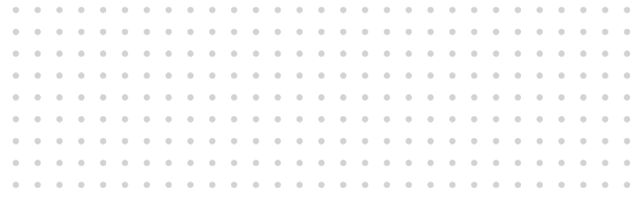
Medical Research & Life Sciences

Our most recent business field arose from a cooperation with renowned medical technology manufacturers from the medical devices sector. PreSens supplies OEM parts, which are integrated into more complex medical systems. Microsensors, sensor spots, and imaging systems are applied in tissue engineering, microfluidics, and many other medical research fields.



Industry & Technical Applications

Robust probes with excellent long-term stability or sensors for contactless measurement find use in technical or industrial applications. Specially designed flow-through connectors for integration in pipes are already applied to monitor the oxygen content in liquids or gases. OEM sensor components can be designed to be integrated in customer systems.



IMAGING

VisiSens™ – 2D Mapping Solutions for O₂, pH or CO₂

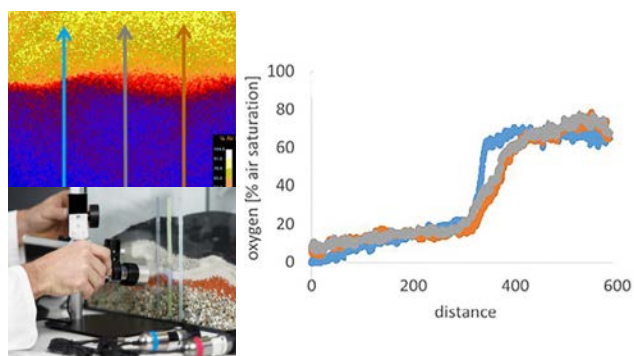
Detecting Spatial and Temporal Analyte Changes

Fluorescent sensor foils combined with 2D read-out technology allow visualization of O₂, pH or CO₂ distributions in heterogeneous samples. For measurement, the sample surface is covered with the sensor foil, which translates the analyte content into a light signal. The sensor response is recorded pixel by pixel with a digital camera. With VisiSens™ spatial and temporal analyte changes can be monitored. VisiSens™ gives an overview over your sample area and allows you to freely choose the region of interest for investigation of spatial and temporal gradients.

- Read-out of O₂, pH or CO₂ sensor foils
- More than 100,000 measurement points within one recorded image
- USB-powered portable microscope detector unit
- Small to medium size field of view (2,1 mm² to 10,8 cm²)
- Image processing and evaluation software included
- Detect and quantify analyte hotspots
- Visualize spatial and temporal gradients
- Time-lapse analyte movies

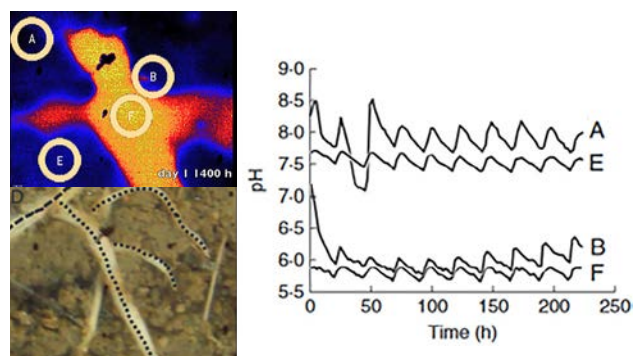
Is your application missing? Contact us and we find your customized solution!

Examples for Applications



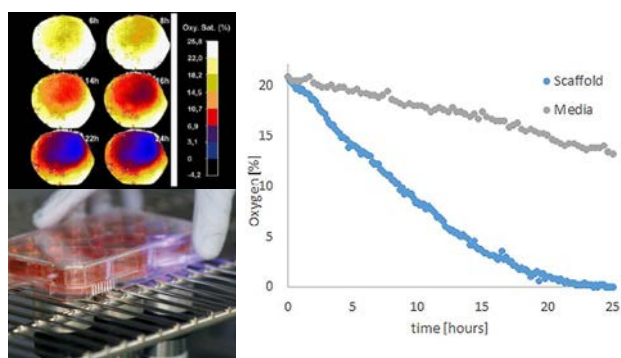
O₂, pH and CO₂ Mapping in Sediments

O₂, pH, and CO₂ are key factors for microbial activity and various geochemical processes in sediments. They highly vary locally, e.g. at interfaces or different depths. Spatial and temporal analyte dynamics over long time periods can be visualized. Various regions can be compared within one measurement. VisiSens™ enables non-invasive 2D-mapping over cross-sections or on sample surfaces. The portable device can be used in lab and field.



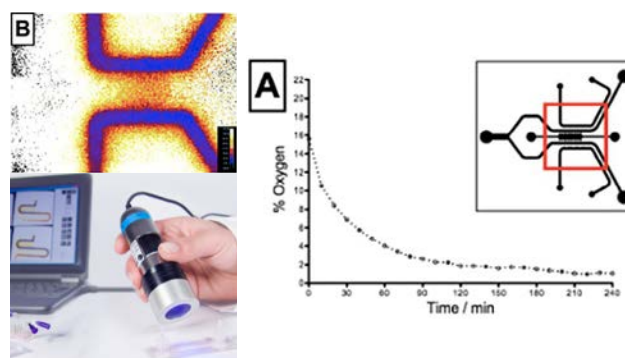
Spatial and Temporal Analyte Changes in Plants and Soil

O₂, pH and CO₂ play a crucial role in plant and soil processes, e. g. in photosynthesis, respiration, in rhizospheres or in microbiological processes. Metabolic processes can be monitored. This planar optical sensor technique allows non-invasive read-out through glass walls of rhizotrons. Studying metabolic activity of roots and determining the cultivation optimum is important for sustainable agriculture, e. g. for adjustment of water and fertilizer supply.



O₂ or pH in Cell Culture and Engineered Tissue

Cellular metabolism critically depends on local O₂ supply and pH values. Especially in 2D and 3D cell culture or engineered tissue, cells located in diffusion limited regions (e. g. in scaffolds or spheroids) can be subject to low oxygen levels and pH changes. Non-invasive, continuous 2D-mapping can be performed directly in the incubator under growth conditions. Furthermore, 2D analyte distributions in living samples can be visualized.



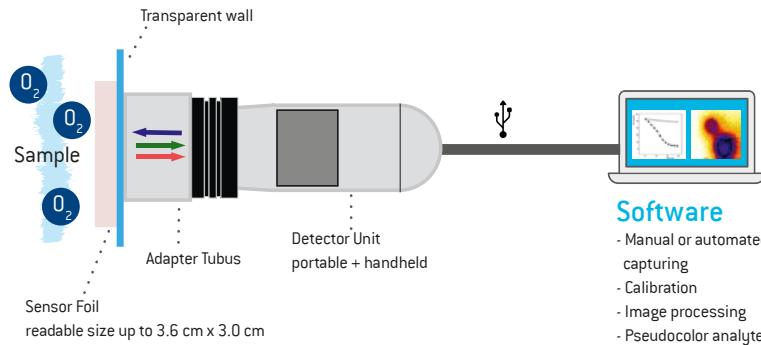
Non-invasive 2D Analyte Mapping in Microfluidics

VisiSens™ enables 2D visualization of important culture parameters inside microfluidic chips. You can continuously monitor in 2D, with high resolution at specific positions or over the whole chip surface in a non-contact read-out mode. Detect metabolic hotspots, record time-series, and monitor hypoxia, cellular growth, or O₂ supply inside the chip. You can gain new insights on metabolic activity and natural or artificially produced gradients.

SPECS

A1 O ₂	0 - 100% a.s. <small>(0 - 20.9% O₂)</small>	
A2 pH	2.5 - 4.5	5.5 - 7.5
A3 pCO ₂	0 - 1%	1 - 25%

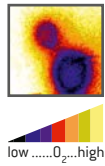
SET-UP



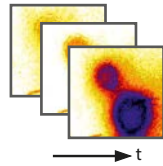
- Software**
- Manual or automated picture capturing
 - Calibration
 - Image processing
 - Pseudocolor analyte maps
 - Time-lapse
 - Free choice of ROI

EXEMPLARY RESULTS

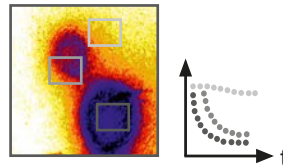
2D Read-Out



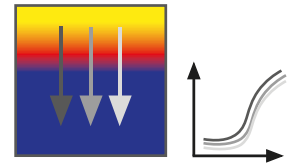
Time Series



Multiple ROI



Gradients



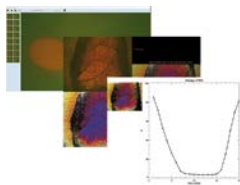
VisiSens™ Detector Units

The handheld cameras are the detectors to read out the fluorescent O₂, pH or CO₂ sensor foils. They are connected to a computer or laptop by USB. A focus control allows for various fields of view from microscopic to 3.6 x 3.0 cm².



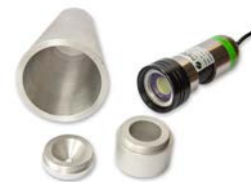
Sensor Foils

The sensor foil can be attached directly on the sample or behind a transparent vessel wall. A sensor film translates the analyte content into a light signal. Foils are available for O₂, pH or CO₂. They can be cut in any desired size or shape.



VisiSens™ AnalytiCal Software

All VisiSens™ software uses the same user interface. They allow for controlling the image recording process and storage, and assist image processing and evaluation. Acquired images can be single images or automatically recorded time series.



Adapter Tubes

Tubes in different sizes can be attached to the VisiSens™ detector units to enable standardized measurement conditions, avoid ambient light coming from the sides and work at fixed fields of view.

Is your application missing? Contact us and we find your customized solution!

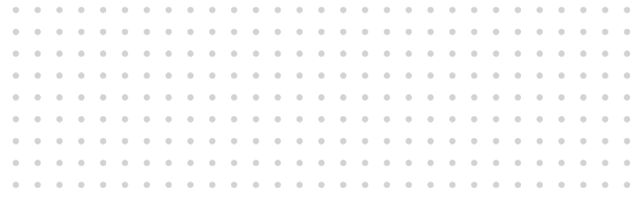
Specifications

	Oxygen (blue)	pH (red)		CO ₂ (green)	
	SF-RPSu4	SF-LV1R	SF-HP5R	SF-CD2R	SF-CD1R
Specifications*					
Measurement range	0 - 100 % air saturation (0 - 20.9 % O ₂)	pH 2.5 - 4.5	pH 5.5 - 7.5	0 - 1 %	1 - 25 %
Response time (t ₉₀)**	Gas phase: < 8 sec. Dissolved: < 30 sec.	< 30 sec.	< 30 sec.	< 3 min.	< 3 min.
Size of sensor foil***	40 x 40 mm ² to 100 x 150 mm ²		40 x 40 mm ² to 100 x 100 mm ²		
Number of sensing points within one image**	300,000				
Measurement temperature range	From + 5 °C to + 45 °C				
Properties					
Compatibility	Aqueous solutions, ethanol (max. 70 % v/v), methanol (max. 10 % v/v), pH 2 - 10	Aqueous solutions, pH 2 - 9, ethanol (max. 10 % v/v)		Aqueous solutions, pH 2 - 9, ethanol (max. 10 % v/v), pH 4 - 9	
Device					
Camera chip	Enhanced Color CMOS				
Image resolution	1.3 megapixel (1280 x 1024 pixels)				
Magnification	10-fold up to 220-fold, depending on adapter tubus used				
Field of view	~ 1.6 x 1.3 mm ² to ~ 3.6 x 3.0 cm ² ; typically ~ 1.2 x 1.0 cm ²				
Output	15 fps live video preview (no storage) and 0.5 fps full-resolution picture storage (.png)				
Number of LEDs	8				
Dimensions	Length 10 cm, diameter 3.8 cm				
Material	ABS housing		All-aluminum housing		
Digital interface	USB 2.0, high speed USB transmission				

*VisiSens™ is no approved medical device

**typical data which may strongly differ with adapting the imaging set-up to specific needs

*** standard product size; sensor foils can be cut with e.g. scissors into desired size or shape



IMAGING

VisiSens™ TD – Modular O₂, pH and CO₂ Mapping System

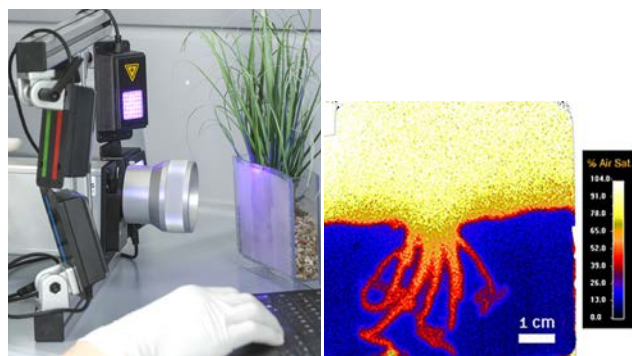
2D Contactless Read-out System for High Resolution, Large Area,
Multi-parameter or Multi-spot Sensing of O₂, pH and CO₂

VisiSens™ TD enables simultaneous 2D read-out of optical O₂, pH and CO₂ sensor foils within one set-up. Planar sensors for one or more analytes are placed on the sample area or in different cavities and the fluorescent sensor signals are read out pixel by pixel with a camera. Fields of view from mm² up to 30 cm x 25 cm are possible. VisiSens™ TD gives an overview over your sample area and allows to freely choose the region of interest for investigation of spatial and temporal gradients or simultaneous read-out of multiple sensor signals. The modular system can be customized according to the user's requirements.

- Three analytes – one system
- Read-out of oxygen, pH and CO₂ sensor foils
- Multiple sensor types combinable in one field of view
- Variable sensor and measurement geometry
- No analyte consumption or electric potential
- Read-out through transparent vessel walls
- Customized 2D sensor systems
- 12-bit detector
- Adaptable field of view, microscopic, 6 x 4 cm² or up to 30 x 25 cm²
- Single- and multi-analyte operation modes
- Time-lapse slide shows of recordings

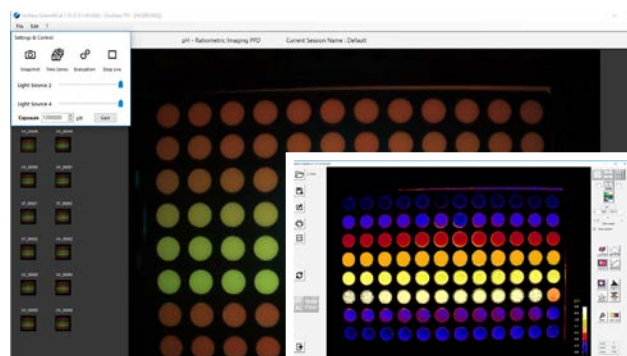
Is your application missing? Contact us and we find your customized solution!

Examples for Applications



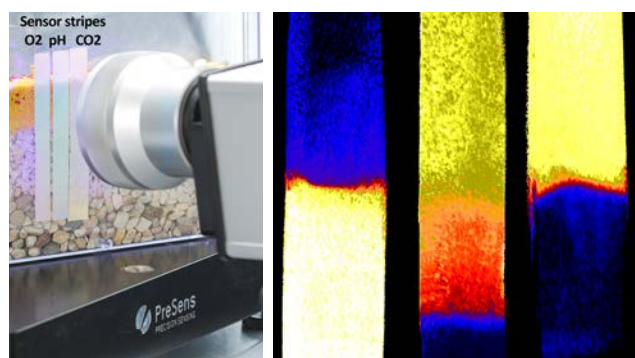
Visualizing Analytes over Large Sample Surfaces

The VisiSens™ TD images large areas and gathers information on spatial and temporal analyte changes, e. g. in large scale pH and CO₂ imaging of root-soil interactions within rhizotrons or while analyzing biogeochemical processes in sediments. It is also well suited for applications in sensitive processes, e. g. metabolic activity of living samples or tissue engineering, where O₂ gradients over a cross section of a 3D graft can be monitored.



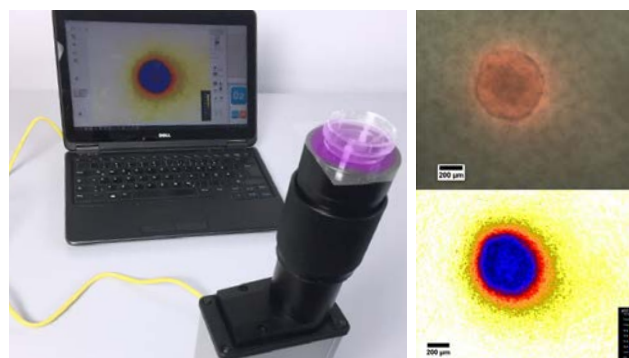
Multi-sample and Multi-sensor Read-out

Large fields of view enable analyte value recording in multiple samples simultaneously with free choice of measurement geometry. Even different sensor ranges can be combined. The fluorescent sensor foils can be mounted at the bottom of transparent vessels, plates or vials containing different samples and placed next to each other, e. g. in a small rack. One image taken from the bottom contains the information on analyte concentrations in a group of samples.



Three Different Analytes with one Device

The modular set-up is applicable for imaging oxygen, pH, and CO₂ sensor foils with one system and in one field of view. It visualizes spatial and temporal changes of analyte concentrations. The combined information on distributions of several analytes can give valuable insight in metabolic activity or chemical processes inside samples, e. g. when investigating complex processes in cell culture, or tissues, in root systems, or when phenotyping crop plants.



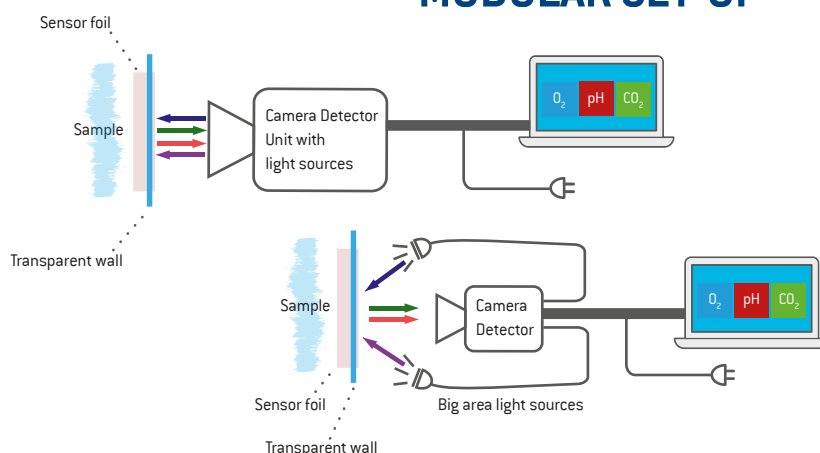
Microscopic Analyte Imaging – TD MIC Configuration

VisiSens™ TD can be equipped with microscope optics for measuring analyte gradients with very high spatial resolution. The VisiSens™ TD MIC can be used e. g. to monitor spatial and temporal changes of O₂ of cross-sections of multicellular tumor spheroids. The system is compact and fits into an incubator to monitor analyte changes under cell culture conditions over days.

SPECS

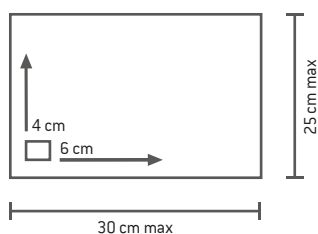
O ₂	0 - 100% a.s. (0 - 20.9% O ₂)	
pH	2.5 - 4.5	5.5 - 7.5
pCO ₂	0 - 1%	1 - 25 %

MODULAR SET-UP

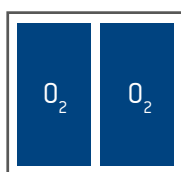


APPLICATION

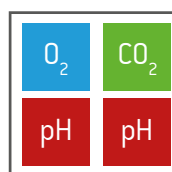
Variable Field of View



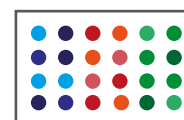
Multi-sensor Set-up



Multi-analyte Set-up



Sensor Array



VisiSens™ TD Basic System

The basic imaging device consists of a 12-bit detector with integrated light sources and mode operation units. It is prepared for reading out O₂, pH and CO₂ sensor foils, even simultaneously in one experiment. The modular concept allows to choose the modalities that are required for the specific application.

Sensor Foils

Sensor foils for O₂, pH and CO₂ in different measurement ranges are available in up to 15 x 10 cm² size. They are placed directly on the sample or inside transparent vessels and read out contactless. A sensitive layer converts the analyte content into a light signal.



VisiSens™ Scientific Software

VisiSens™ TD includes a modular control and evaluation software. One can choose between different operation modes from single- to multi-analyte modes. Snapshots or automatic time series recordings are possible.



Customized VisiSens™ TD

VisiSens™ TD offers a broad range of possible modifications with different lenses, light sources, and operation modes. Various accessories allow to further customize the system according to the specific experimental needs.

Is your application missing? Contact us and we find your customized solution!

Specifications

	Oxygen (blue)		pH (red)		CO ₂ (green)	
	SF-RPSu4	SF-LV1R	SF-HP5R	SF-CD2R*	SF-CD1R	
Specifications						
Measurement range	0 - 100 % air saturation (0 - 20.9 % O ₂)	pH 2.5 - 4.5	pH 5.5 - 7.5	0 - 1 % pCO ₂ at atmospheric pressure (1013.15 hPa)	1 - 25 % pCO ₂ at atmospheric pressure (1013.15 hPa)	
Response time (t ₉₀)**	Gas phase: < 8 sec. Dissolved: < 30 sec.	< 30 sec.	< 30 sec.	< 3 min.	< 3 min.	
Limit of detection***	0.03 % air saturation					
Precision (temporal)****	± 0.02 % air saturation at 0 % air saturation; ± 0.1 % air saturation at 100 % air saturation	± 0.01 pH at pH 4	± 0.01 pH at pH 7	± 0.02 % CO ₂ at 0.15 % CO ₂ ; ± 0.01 % CO ₂ at 0.8 % CO ₂	± 0.02 % CO ₂ at 2 % CO ₂ ; ± 0.1 % CO ₂ at 25 % CO ₂	
Precision (spatial)*****	± 1.5 % air saturation at 0 % air saturation; ± 3 % air saturation at 100 % air saturation	± 0.1 pH at pH 4	± 0.1 pH at pH 7	± 0.08 % CO ₂ at 0.15 % CO ₂ ; ± 0.08 % CO ₂ at 0.8 % CO ₂	± 0.2 % CO ₂ at 2 % CO ₂ ; ± 1.2 % CO ₂ at 25 % CO ₂	
Properties						
Compatibility	Aqueous solutions, ethanol (max. 70 % v/v), methanol (max. 10 % v/v), pH 2 - 10	Aqueous solutions, pH 2 - 9 ethanol (max. 10 % v/v)		Aqueous solutions, pH 4 - 9 ethanol (max. 10 % v/v)		
General sensor temperature working range	from + 5 °C to + 45 °C					
System Components						
	Ratiometric Imaging					
Hardware	O₂		pH			CO₂
VisiSens TD Basic System*	x		x			x
Big Area Imaging kit*	x		x			x
TD MIC Configuration*	x					
Software						
VisiSens Scientifical*						
Imaging Modality O ₂ *	x					
Imaging Modality pH*			x			
Imaging Modality CO ₂ *						x
Mixed dual or triple modes*	x		x			x
Sensor						
SF-RPSu4	x					
SF-HP5R			x			
SF-LV1R			x			
SF-CD1R						x
SF-CD2R*						x
Accessories (optional)						
CaliPlate - pH Calibration Helper Plate						
Mounting Rack*						
Sensor Plate Tubus Adapter*						
Resolution Test Chart*						
Plates with Integrated Sensor Foils*						

* Prototype component; please contact our service team!

** Typical data which may strongly differ with adapting the imaging set-up to specific needs

*** Typical data of LOD of a defined ROI (> 6,000 pixels) over time in dark lab conditions at 20 °C, FoV 8 cm x 6 cm

**** Typical data of temporal variation in a defined ROI (> 6,000 pixels) over time in dark lab conditions at 20 °C, FoV 8 cm x 6 cm

***** Typical data of spatial standard deviation in defined ROI (> 6,000 pixels) in dark lab conditions at 20 °C, FoV 8 cm x 6 cm

Product Matrix

		Meters					
		VisiSens™ A1, A2, A3 (p. 6)			VisiSens™-TD (p. 10)		
		Detector Unit DU01	Detector Unit DU02	Detector Unit DU03	O ₂	pH	CO ₂
Sensors	Sensors (p. 15 - 16)						
	SF-RPSu4	x			x		
	SF-HP5R		x			x	
	SF-LV1R		x			x	
	SF-CD1R			x			x
	SF-CD2R			x			x
	Self-adhesive Sensor Foils	x	x		x	x	x
Hardware	Hardware (p. 17 - 18)						
	VisiSens TD Basic System				x	x	x
	VisiSens TD Big Area Imaging Kit				x	x	x
	VisiSens TD Mounting Rack				x	x	x
	TD MIC Configuration				x		
Software	Software (p. 15 - 17)						
	VisiSens AnalytiCal 1	x					
	VisiSens AnalytiCal 2		x				
	VisiSens AnalytiCal 3			x			
	VisiSens AnalytiCal 4	x	x	x			
	VisiSens ScientifiCal				x	x	x
	Imaging Modality O ₂				x		
	Imaging Modality pH					x	
	Imaging Modality CO ₂						x
	Mixed modes				x	x	x
Accessories (optional)	Adapter Tubes (p. 16)	x	x	x			
	CaliPlate for pH Sensors (p. 15)		x			x	
	Resolution Test Chart	x	x	x	x	x	x
	Plates with Integrated Sensor Foils (p.18)	x	x		x	x	

Is your application missing? Contact us and we find your customized solution!

Product Range

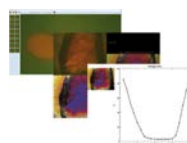
VisiSens™ Oxygen

O₂



Detector Unit DU01

USB powered and portable 2D detection device for oxygen imaging



Software VisiSens™ AnalytiCal 1

Software for measurement control and evaluation of oxygen images



Oxygen Sensor Foil SF-RPSu4

Fluorescent sensor foil for oxygen imaging from 0 – 100 % air saturation

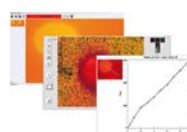
VisiSens™ pH

pH



Detector Unit DU02

2D read-out device for pH sensor foils



Software VisiSens™ AnalytiCal 2

Software for measurement control and evaluation of pH images



pH Sensor Foil SF-HP5R

Fluorescent sensor foil for measurements in a range of 5.5 – 7.5 pH



CaliPlate for SF-HP5R

Calibration helper; 10-well plate equipped with pH sensor foil SF-HP5R



pH Sensor Foil SF-LV1R

Fluorescent sensor foil for measurements in low pH range from 2.5 – 4.5 pH



CaliPlate for SF-LV1R

Calibration helper; 10-well plate equipped with pH sensor foil SF-LV1R

VisiSens™ CO₂

CO₂

Detector Unit DU03

USB powered and portable 2D detection device for CO₂ imaging



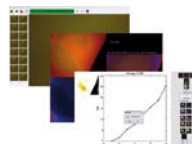
CO₂ Sensor Foil SF-CD1R

The CO₂ sensor foil SF-CD1R has a measuring range of 1 – 25 % CO₂ and is suitable for measurements in liquids or samples with a constant relative humidity of 100 %.



CO₂ Sensor Foil SF-CD2R

This sensor foil is for measurements in low CO₂ range of 0 – 1 %; it is suitable for measurements in liquids or samples with a constant relative humidity of 100%.



Software VisiSens™ AnalytiCal 3

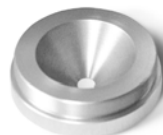
Software for measurement control and evaluation of CO₂ images

Accessories



Adapter Tube 1

Standard adapter tube that comes with the VisiSens™ detector units; typical field of view of ~ 12 x 10 mm²



Adapter Tube 2

Adapter tube for VisiSens™ detector units with typical field of view of ~ 1.7 x 1.3 mm²



Adapter Tube 4

Adapter tube for VisiSens™ detector units with typical field of view of ~ 36 x 30 mm²



VisiSens™ AnalytiCal 4 Software

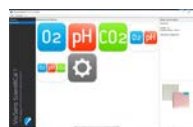
Software for measurement control of up to three different VisiSens™ detector units

VisiSens™ TD



VisiSens™ TD Basic System

Modular imaging detector unit that can be equipped with various imaging modalities for read-out of O₂, pH or CO₂ sensor foils



VisiSens™ ScientifiCal Software

VisiSens™ TD Software for measurement control and evaluation of recorded data; the modular software offers various operation modes from single- to multi-analyte modes.



Oxygen Sensor Foil SF-RPSu4

Fluorescent sensor foil for oxygen imaging from 0 – 100 % air saturation



pH Sensor Foil SF-HP5R

Fluorescent sensor foil for measurements in a range of 5.5 – 7.5 pH



CaliPlate for SF-HP5R

Calibration helper; 10-well plate equipped with pH sensor foil SF-HP5R



pH Sensor Foil SF-LV1R

Fluorescent sensor foil for measurements in low pH range from 2.5 – 4.5 pH



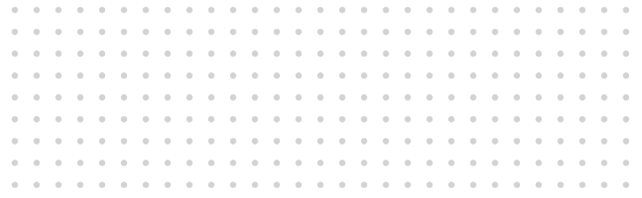
CaliPlate for SF-LV1R

Calibration helper; 10-well plate equipped with pH sensor foil SF-LV1R



CO₂ Sensor Foil SF-CD1R

Fluorescent sensor foil SF-CD1R for the range of 1 – 25 % CO₂; suitable for measurements in liquids or samples with a constant relative humidity of 100%



CO₂ Sensor Foil SF-CD2R

Low CO₂ range (0 – 1 %) sensor foil; suitable for measurements in liquids or samples with a constant relative humidity of 100 %



Self-adhesive Sensor Foils

O₂ and pH sensor foils are also available with self-adhesive backside for easy sensor implementation



VisiSens TD Mounting Rack

Rack for mounting camera detector and light sources in various modifications



Big Area Light Sources

Mixed excitation light sources for read out of 8 x 6 cm² to a max of 30 x 25 cm² field of view



24-Well O₂ or pH Plates

24-well plates with integrated sensor foils for O₂ or pH; read-out of all wells in one image possible; beta-irradiation service offered.



96-Well O₂ or pH Plates

96-well microtiterplates with integrated sensor foils for O₂ or pH; read-out of all wells in one image possible; beta-irradiation service offered.



VisiSens™ TD MIC Modification

Optics and excitation light source for microscopic O₂ imaging



Notes

A large grid of graph paper for taking notes, consisting of 20 columns and 30 rows of small squares.

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Sensors & Meters

Optical CO₂
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PRECISION SENSING
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