

# Oxygraph+

Liquid-phase oxygen electrode system  
for photosynthesis & respiration studies



*Hansatech*  
Instruments



# Oxygraph+

Liquid-phase oxygen electrode system for photosynthesis & respiration studies

- > PC operated oxygen electrode control unit with USB connectivity
- > Clear cast acrylic DW1/AD oxygen electrode chamber with integral Clark type polarographic oxygen electrode
- > Suitable for liquid-phase samples with 0 – 100% oxygen concentration
- > 24 bit high resolution measurement of oxygen signals
- > Integral systems for measurement of pH & other ion-selective electrode signals with 16 bit resolution
- > System expansion to 8 channels via purchase of additional Oxygraph+ systems
- > OxyTrace+ Windows® software for data acquisition, hardware control & data analysis
- > Real time 0 – 4.5v analogue output of oxygen electrode signal



## Oxygraph+ electrode control unit

The next generation Oxygraph+ oxygen electrode control unit combines striking aesthetics with enhanced features and functionality offering significant advances in flexibility and performance over previous generations of electrode control units. As a complete system, Oxygraph+ provides a convenient yet powerful tool for measurements of oxygen evolution or uptake across a broad range of liquid-phase samples from chloroplast extractions to mitochondrial suspensions with oxygen concentrations up to 100%.

Oxygraph+ offers unrivalled price vs. performance combining simplicity of operation with an enviable feature set. The outstanding flexibility ensures Oxygraph+ is equally useful in both a teaching and research capacity.

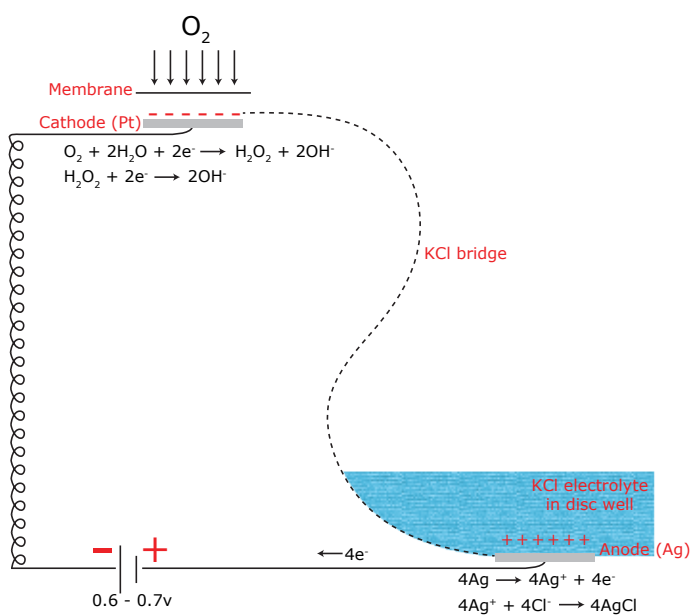
24 bit resolution allows detection of minute changes in oxygen tension without needing to apply instrument gain. This results in beautiful, noise free traces even when zoomed close in on areas of interest. Oxygraph+ allows realtime graphing of signals from auxiliary inputs and ion-selective electrodes. This allows comprehensive analysis of oxygen activity simultaneously with signals such as pH, TPP+, calcium, potassium and hydrogen ions.

Up to 8 individual Oxygraph+ control units may be linked to a single PC and operated simultaneously from OxyTrace+ software providing a powerful, multi-channel system.



## Oxygen electrode disc

Since its original design in the early 1970's by Tom Delieu and David Walker, the S1 Clark Type Oxygen Electrode disc remains largely unchanged – a true testament to the quality and reliability of the sensor. The S1 consists of a platinum cathode and silver anode set into an epoxy resin disc and is prepared for use by trapping a layer of 50% saturated KCl solution beneath an oxygen permeable PTFE membrane. A paper spacer placed beneath the membrane acts as a wick to provide a uniform layer of electrolyte between anode and cathode.



When a small voltage is applied across these electrodes (with the platinum negative with respect to the silver), the current which flows is at first negligible and the platinum becomes polarised (i.e. it adopts the externally applied potential). As this potential is increased to 700 mV, oxygen is reduced at the platinum surface, initially to hydrogen peroxide  $H_2O_2$  so that the polarity tends to discharge as electrons are donated to oxygen (which acts as an electron acceptor). The current which then flows is stoichiometrically related to the oxygen consumed at the cathode.

When connected to Oxygraph+, the S1 provides a fast, effective and accurate method of detecting small changes in oxygen tension in a liquid-phase sample.



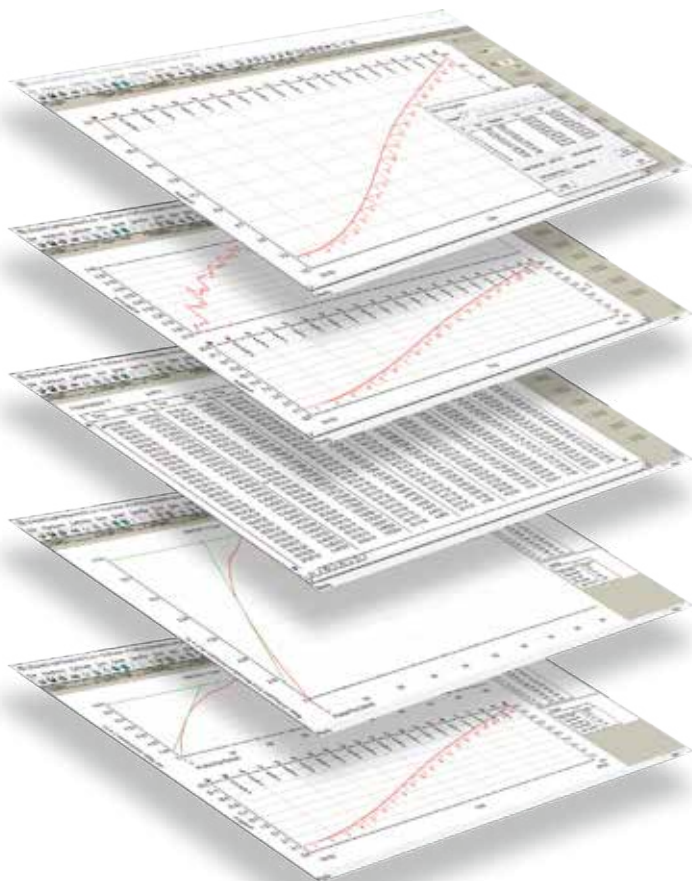
## DW1/AD electrode chamber

A component that has proved itself time and again over 4 decades, the DW1/AD electrode chamber offers quality and versatility in measurements of dissolved oxygen. Developed in conjunction with the great Prof. David Walker, the DW1/AD provides a highly flexible solution for a wide range of applications covering both teaching and research in plant and biomedical science.

The reaction vessel of the DW1/AD is constructed from precision bore borosilicate glass tube with a prepared S1 electrode disc forming the floor of the vessel. Precision temperature control of sample and sensor is delivered via a concentric water jacket with suitable connection ports for a thermoregulated circulating water bath.

DW1/AD is fitted with a gas-tight plunger with a stoppered central bore. The height of the plunger may be adjusted easily to suit liquid-phase sample volumes of between 0.2 - 2.5ml whilst the central bore easily accommodates Hamilton type syringes allowing additions/subtractions to/from the reaction vessel during an experiment.

The clear acrylic construction allows high sample visibility and uniform sample illumination using external light sources where necessary.



## OxyTrace+ software

OxyTrace+ is a multi-function Windows® program supplied with Oxygraph+ for system configuration, calibration, data acquisition and analysis.

An automated 2 step calibration routine guides the user quickly and effectively through the system calibration process using electrode values measured from air-saturated and deoxygenated water.

A tabbed interface allows a simple transition between the different data views including oxygen electrode (and if configured, auxiliary and external ion-selective electrode) real-time output, a split screen showing real-time rate of change above the oxygen signal and tabulated numerical data.

Post acquisition analysis tools allow automatic calculation of oxygen rates from user-defined rate intervals with saved Comma Separated Values (CSV) data files opening effortlessly in external data processing packages such as MS Excel®.

OxyTrace+ will run on all supported Microsoft operating systems.



## System components

Oxygraph+ systems are supplied with the following components:

- OXYG1+: Oxygraph+ electrode control unit
- DW1/AD: Electrode chamber
- S1: Oxygen electrode disc and SMB-SMB connection cable
- A2: Membrane applicator to assist with smooth application of electrode membrane
- A3: Top plate key and alignment jig to dismantle and reassemble DW1/AD for cleaning
- S2/P: Pack of 5 magnetic followers
- S3: Pack of 2 replacement borosilicate glass reaction vessels
- S4: Reel of PTFE membrane (0.0125mm x 25mm x 33m)
- S7A: Set of replacement o-rings for DW1/AD
- S16: Cleaning kit for the S1 electrode disc.

## Related systems

Oxytherm+ systems feature custom electrode chambers which are designed with an integral Peltier element providing effective sample and electrode disc temperature control between 3 - 40°C. The Oxytherm+P (specifically designed for photosynthesis measurements) is fitted with dual white LED's which provide actinic illumination of the reaction vessel contents up to 4000 $\mu$ mol m<sup>-2</sup> s<sup>-1</sup>.

For further information, please contact Hansatech instruments or visit our website.



## Technical specifications

### Oxygraph+ electrode control unit

Measuring range:	Oxygen: 0 - 100%   pH: 0 - 14pH   Aux: 0 - 4.096V
Signal inputs:	Oxygen electrode (SMB)   pH/ISE (BNC)   Auxiliary (8 pin Mini Din)
Resolution:	Oxygen: 0.0003% (24 bit)   pH: 0.0006pH (16 bit)   Aux: 62.5µV/bit (16 bit)
Polarising voltage:	700mV
Input sensitivity:	0 - 9000nA
Magnetic stirrer:	Software controlled 150 - 900rpm in % steps
Sampling rate:	0.1 - 10 readings/s
Electronics:	Microcontroller: 16 bit high performance CPU running at 32 MHz ADC: Dual, Low power, 16/24 Bit Sigma Delta
Communications:	USB2.0
Analogue output:	0 - 4.5V O <sub>2</sub> signal
Dimensions (HWD):	200 x 110 x 60mm
Weight:	0.45 Kg
Power:	12V dc @ 100mA, 90Vac - 264Vac @ 1A

### DW1/AD electrode chamber

Suitability:	Liquid-phase respiration/photosynthesis
Construction:	Clear cast acrylic
Sample chamber:	Precision bore, borosilicate glass tube
Sample volume:	0.2 - 2.5ml
Temperature control:	Water jacket connected to thermoregulated circulating water bath
Dimensions (DH):	65 x 105mm
Weight:	100g
Plunger:	Variable height plunger assembly with central bore for sample additions

### S1 oxygen electrode disc

Electrode type:	Clark type polarographic oxygen sensor
Electrode output:	Typically 1.6µA at 21% O <sub>2</sub>
Residual current:	Typically 0.04µA in 0% O <sub>2</sub>
Response time:	10 - 90% typically < 5 seconds
Oxygen consumption:	Typically <0.015µmol/hr <sup>-1</sup>



Hansatech Instruments is a British company that has been developing high quality scientific instrumentation for over 40 years. Our systems are used widely for teaching & research in cellular respiration & photosynthesis programs in more than 100 countries throughout the world. We have gained an enviable reputation for quality, reliability & excellent price/performance.



Our product range consists of a range of modular solutions for the measurement of oxygen using Clark type polarographic sensors. We also develop chlorophyll fluorescence measurement systems using both continuous excitation & pulse-modulated measurement techniques with further optical instrumentation for the measurement of sample chlorophyll content.



Purchasers of Hansatech Instruments products can be assured of ongoing support & prompt & efficient attention to enquiries at all times. Support is available both directly & from our global distributor network. Customers are encouraged to register their instruments on our website which allows access to our Support Ticketing System in addition to instruments manuals & software upgrades.

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