

CHLOROLAB 2 SYSTEM

- Convenient, system for the advanced study of photosynthesis & respiration measurements in liquid-phase samples under illumination.
- DW2/2 liquid-phase electrode unit with integral oxygen electrode.
- Oxylab unit for direct PC control and data acquisition.
- Sample mixing by integral stirrer driving a magnetic follower.
- 4 optical ports for illumination via LH11/2R high intensity red LED probes.
- Quantitherm light/temperature sensor for light calibration.
- System calibration & control via Windows® Software.

Overview

Chlorolab 2 provides a sophisticated system for the advanced study of respiration and photosynthesis from liquid samples under automated illumination from red (660nm) LED light. The system provides the ability to automate the acquisition of oxygen evolution/uptake rate over a user-defined light intensity rate and to determine the apparent quantum yield. The system is ideally suited to busy research facilities where demands on equipment performance are high but is equally at home in teaching environments for under & post-grad plant biology studies of the photosynthetic processes.

Samples are typically between 0.2 - 2.5ml and consist of suspensions of extracted chloroplasts, micro-algae etc. Changes in oxygen concentration of the sample medium are determined by the integral oxygen electrode mounted in the base of the chamber.

The system comprises the Oxylab control unit, S1 Clark type electrode disc, DW2/2 liquid-phase electrode chamber, LH11/2R red LED light source and QRT PAR/temperature sensor for light

source calibration. All necessary accessories and spares are also included (excluding circulating water bath and PC).

Components of the System

The Chlorolab 2 system consists of the following individual items:

OXYLI Oxylab Control Unit

The Oxylab oxygen electrode control unit is designed to provide PC control of oxygen uptake or evolution measurements across a broad range of applications from studies of mitochondrial and cellular respiration to measurements of isolated chloroplast suspensions or solid state leaf samples in photosynthesis research.

The Oxylab control unit provides an effective tool for the measurement of oxygen signals from the S1 Clark type oxygen electrode. Simultaneous recording of an optional auxiliary input signal (e.g. temperature, pH, chlorophyll fluorescence, TPP+ or other specific ion electrodes etc) is also possible using the appropriate apparatus.

The Oxylab control unit connects to the serial port of a Windows® PC either directly or using a HAN/USB adapter (for newer PC's with no serial ports). The control unit features a built-in magnetic stirrer (for liquid-phase measurements) and all the electronics required to control and measure the signal from the S1 oxygen electrode disc. Additional Oxylab functionality provides automation of complex light intensity changes during light response assays. Light tables (or photon flux density tables) are created within the Oxylab software via a user-friendly interface.

Oxylab32 Windows® software controls all major hardware and data acquisition functions including signal gain and back-off and simple calibration routines for both liquid and gas-phase measurements. Data from the S1 electrode disc, optional auxiliary input signal and temperature signal from a QTP1 PAR/Temperature probe sensor (not supplied) are plotted as a chart recorder emulations in "real-time" with post-measurement data analysis tools included within the program. Completed experiments may be exported as an ASCII file which then may be opened in other Windows® data analysis applications such as Excel®.

DW2/2 Electrode Chamber

The DW2/2 electrode chamber has been designed for use with other instruments to allow simultaneous spectroscopic and oxygen flux measurements. The reaction vessel in the DW2/2 is a precision bore borosilicate glass tube with a prepared S1 oxygen electrode disc forming the floor of the reaction vessel during measurements. A surrounding black acetal water jacket provides the facility for dark adaptation of samples or oxygen measurement in complete darkness.

Four optical ports mounted perpendicular to the reaction vessel at right angles to one another allow light sources, fibre optic light guides and detectors to be mounted on the DW2/2 allowing spectroscopic measurements to be made.

S1 Oxygen Electrode Disc

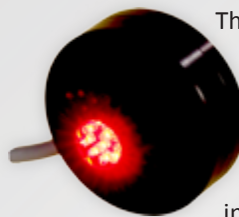
The Chlorolab 2 system is based around the S1 Clark type polarographic oxygen electrode disc. When fitted, the dome of the electrode disc forms the floor of the electrode chamber reaction vessel providing a sensitive and rapid response to small changes in oxygen tension within the sample.



The electrode disc comprises a central platinum cathode and a concentric silver anode. Preparation includes the addition of electrolyte and the application of a thin oxygen permeable P.T.F.E. membrane to the electrode dome. Once prepared and positioned in the electrode chamber, the disc is connected to the Oxylab control circuitry which applies a small polarising voltage between the electrodes. In the presence of oxygen, a small current is generated proportional to oxygen activity in the sample.

LH11/2R Red LED Light Source

The LH11/2R light source consists of 11 red LED's centered on 650nm arranged for optimum uniformity across the illuminated area. The LH11/2R is designed primarily for use with the DW2/2 although it is possible to insert the LH11/2R into the 16mm internal diameter optical port of the LD2/3 and DW3 (via 16mm internal diameter reducing adapter) electrode chambers. One or more light housings may be used in conjunction with the Oxylab electrode control unit to provide up to approx. 1200 $\mu\text{mol m}^{-2} \text{s}^{-1}$ light intensity per housing in the DW2/2 reaction vessel.



QRT1 PAR/Temperature Sensor

The QRT1 with QTP1 probe sensor is a handheld PAR sensor combined with a thermometer. The QTP1 probe mounts vertically in the reaction vessel of the DW1 electrode unit & permits calibration of incident light & temperature in the chamber.



Technical Specifications

OXYLI Oxylab Electrode Control Unit

Measuring Range	0 - 40% oxygen
Min. O ₂ Resolution	Typically 10 x 10 ⁻⁵ $\mu\text{mol/ml}$ at 20 °C
Integral Magnetic Stirrer	Yes (software controlled 150 - 900 rpm)
Polarising Voltage	700 mV
Gain/Back Off Control	Software adjustable. Gain: up to x50 (10 bit resolution) Back off: 12 bit resolution
Integral Test Resistor	Yes
Data Acquisition Rate	Software selectable between 0.2 - 10 readings per second
Signal Inputs	Electrode disc, Auxiliary input, QTP1 PAR/temperature probe
Communications	Bi-directional RS232. USB using HAN/USB adapter
Dimensions	250 (w) x 126 (d) x 65mm (h). Weight: 650gms
Power Supply	95 - 260V universal input mains supply. Output 12V DC 2.5A
Electrode Chamber Compatibility	All Hansatech Instruments electrode chambers
Additional Information	Automated control of external LH11/2R or LH36/2R LED arrays

DW2/2 Oxygen Electrode Chamber

Measurement Suitability	Liquid-phase respiration/photosynthesis
Construction	Black acetal
Sample Chamber	Precision bore, borosilicate glass tube
Sample Volume	0.2 - 2.5ml (min. 1.5ml if illuminated)
Optical Ports	4 optical port (16mm dia)
Temperature Control	Water jacket connected to circulating water bath
Dimensions	65 (d) x 105mm (h). Weight 100g

S1 Oxygen Electrode Disc

Electrode Type	Clark type polarographic oxygen sensor
Electrode Output	Typically 1 μA at 21% O ₂ . Residual current in 0% O ₂ typically 0.02 μA
Response Time	10 - 90% typically < 5 seconds
Oxygen Consumption	Typically < 0.015 $\mu\text{mol hr}^{-1}$

LH11/2R Red LED Light Source

Lamp Type	11 x red LED (650 nm peak)
Power Supply	Requires Oxylab oxygen electrode control unit for power
Intensity Adjustment	Automatic intensity control via Oxylab oxygen electrode control unit & software
Dimensions	55 mm (dia) x 31 mm (h). Weight: 108g
Max. Intensity in Chambers	1200 $\mu\text{mol m}^{-2} \text{s}^{-1}$ in DW2/2. Higher intensities possible using up to 3 LH11/2R units

QRT1 PAR/Temperature Sensor

Measuring Range	0 - 50000 $\mu\text{mol m}^{-2} \text{s}^{-1}$ (+/- 5%) in 2 ranges (0 - 5000 and 0 - 50000) in 400 - 700nm waveband
Resolution	1 $\mu\text{mol m}^{-2} \text{s}^{-1}$ at 0 - 5000, 10 $\mu\text{mol m}^{-2} \text{s}^{-1}$ at 5001 - 50000
PAR Sensor	Silicon photodiode/optical filter combination with white acetal diffuser (7mm diameter)
Temperature Sensor	RT curve matched bead type thermistor. 0 - 50°C/32 - 122°F. 0.02°C resolution
Signal Display	Handheld display unit. 16 x 2 LCD display. 0 - 5V analogue output of PAR/temperature values
Power Requirement	4 x 1.5V AA (LR6) cells. Typically 100 hours battery life
Dimensions	Display: 146 (h) x 92 (w) x 32mm (d). Weight: 300g (including batteries). QTP1 probe: 9.5 (dia.) x 107mm (length). Weight: 50g