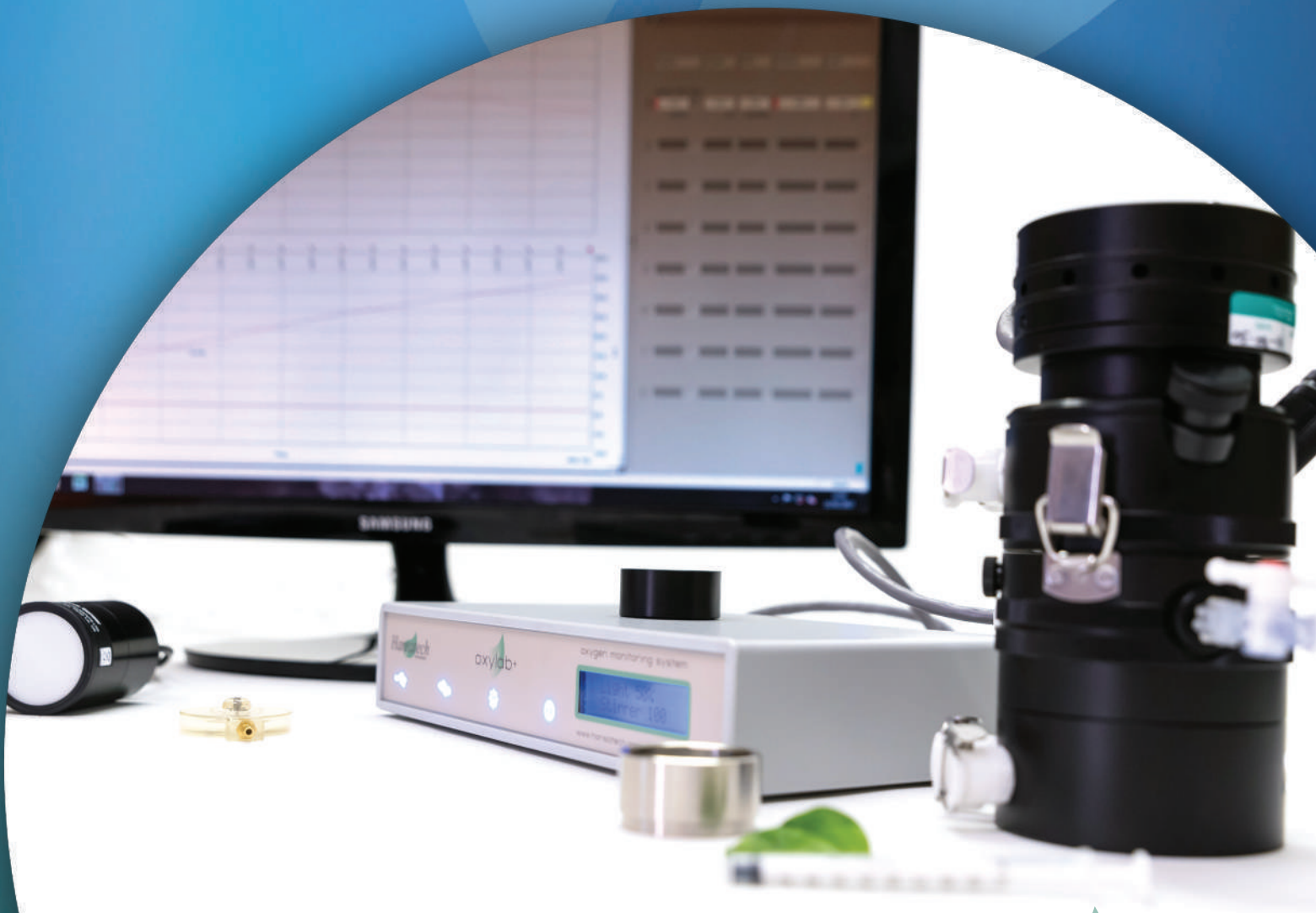
Leaflab 2+

Gas-phase oxygen electrode system for advanced photosynthesis & respiration studies



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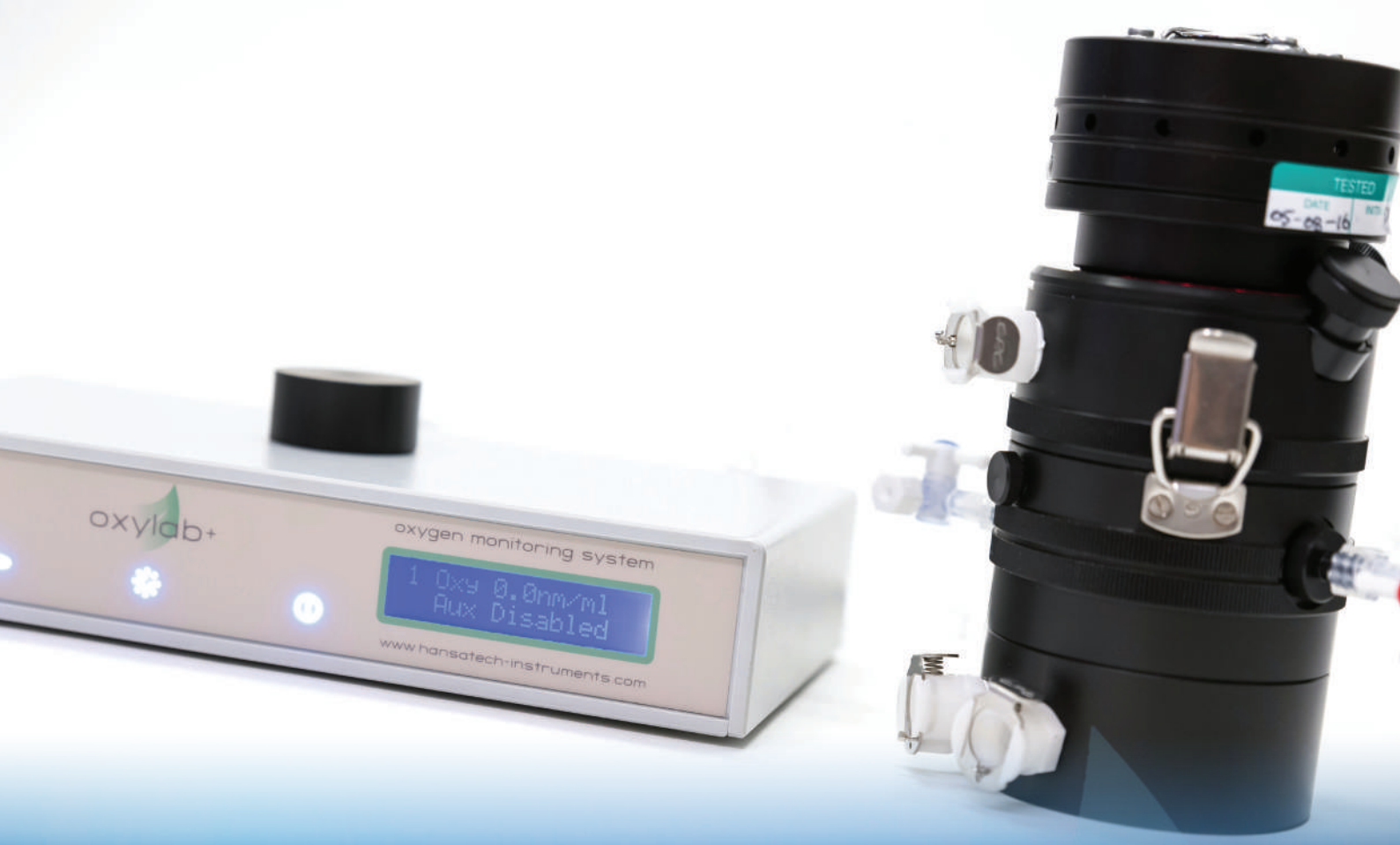


Leaflab 2+

Gas-phase oxygen electrode system for advanced photosynthesis & respiration studies

- PC operated USB Oxylab+ electrode control unit
- LD2/3 gas-phase electrode chamber with dual water jacket for effective sample/sensor temperature control
- LH36/2R LED light source (up to 750 µmols m^{-2} s^{-1}) with automated control via user-defined PFD light tables
- Suitable for gas-phase measurements from leaf disc samples of 10cm^2
- 24 bit high resolution measurement of oxygen signals
- Integral systems for measurement of auxiliary signals with 16 bit resolution
- Onboard LCD readings of oxygen & auxiliary signals
- 2 channel capability via purchase of additional systems
- QSRED sensor for light source calibration
- OxyTrace+ Windows® software for data acquisition, hardware control & data analysis
- Real time 0 – 4.5v analogue output of oxygen signal

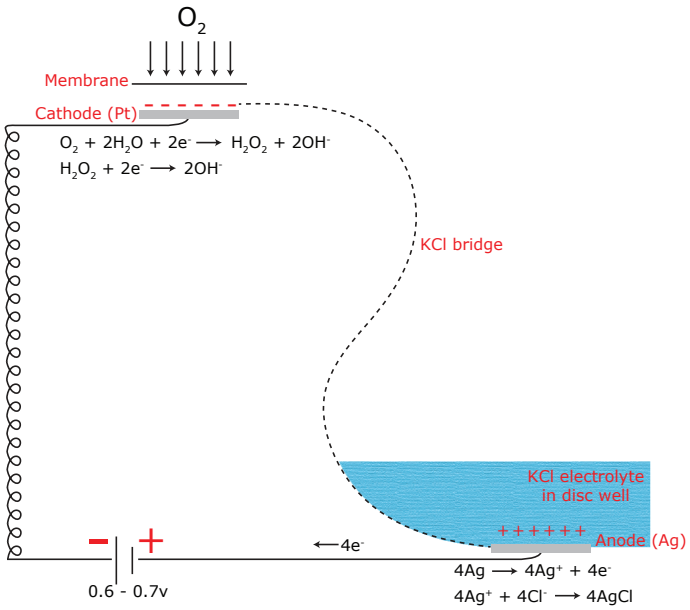
Oxylab+ electrode control unit

The next generation Oxylab+ 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 unit. As part of a complete system, Oxylab+ provides a convenient yet powerful tool for measurements of oxygen evolution or uptake from samples in the gas-phase between 0 - 100% oxygen. Samples typically consist of leaf discs which are either cut from a broad leaf or made up of a “mat” of other material such as excised needles, algae, mosses, lichens etc to form a circular disc of 10cm^2.

Oxylab+ offers unrivalled price vs. performance combining simplicity of operation with an enviable feature set. The outstanding flexibility ensures Oxylab+ is equally useful in both a teaching and research capacity. 24 bit resolution allows detection of minute changes in oxygen level without needing to apply instrument gain. This results in beautiful, noise free traces even when zoomed close in on areas of interest. Integral electronics provide control over an LED light source with automatic intensity changes handled by user-defined PFD light tables in software.

The system allows realtime graphing of signals from the S1 oxygen electrode and an optional auxiliary input providing scope for comprehensive analysis of oxygen activity. Signals from all inputs are additionally displayed on an LCD screen mounted within the front panel of the Oxylab+ control unit.

Up to 2 individual Oxylab+ 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 providing a fast, effective method of detecting small changes in oxygen level in a gas-phase sample.

LD2/3 electrode chamber

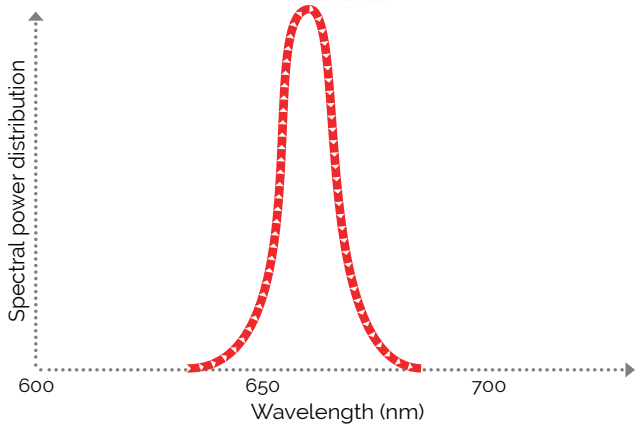
The LD2/3 leaf-disc electrode chamber allows oxygen uptake / evolution measurements to be performed from leaf-discs, excised needles, algae, mosses, lichens etc with a surface area of up to 10cm^2. A prepared S1 oxygen electrode disc is mounted directly below the sample chamber with the dome of the electrode forming the chamber floor.

LD2/3 provides precision temperature control of sample and sensor via upper and lower water jackets fitted with self-sealing ports for connection to a thermoregulated circulating water bath.

The LD2/3 is constructed from black acetal which provides the ability for dark adaptation of samples or oxygen measurement in complete darkness.

The leaf chamber section has 2 gas ports providing both a calibration and flow-through capability for rapid changes in the gaseous environment above the sample. An additional tapped and stoppered hole is provided for the introduction of an optional temperature sensor or similar auxiliary sensor.

A clear cast acrylic top window allows illumination of the sample via the LH36/2R LED light source with a further 16mm optical port for either additional illumination or insertion of a quantum sensor, etc. An additional port is orientated more steeply towards the sample and allows the fibre optic cable from the FMS 1 and FMS 2 modulated fluorimeters to be positioned close to the sample allowing simultaneous measurement of chlorophyll fluorescence.



LH36/2R light source

The LH36/2R light housing is designed specifically for use with the LD2/3 leaf disc electrode chamber. The light housing mounts directly on to the clear cast acrylic window on the top of the LD2/3.

The large area LED array consists of 36 red LED's arranged in such a way to provide a high uniformity of illumination of sample discs of 10cm^2.

LH36/2R connects directly to the rear of the Oxylab+ electrode control unit. Light intensity adjustments are made automatically based on user-defined PFD tables within OxyTrace+ software. PFD tables consist of up to 20 individual steps allowing complex light response assays to be configured for automatic execution during a measurement.

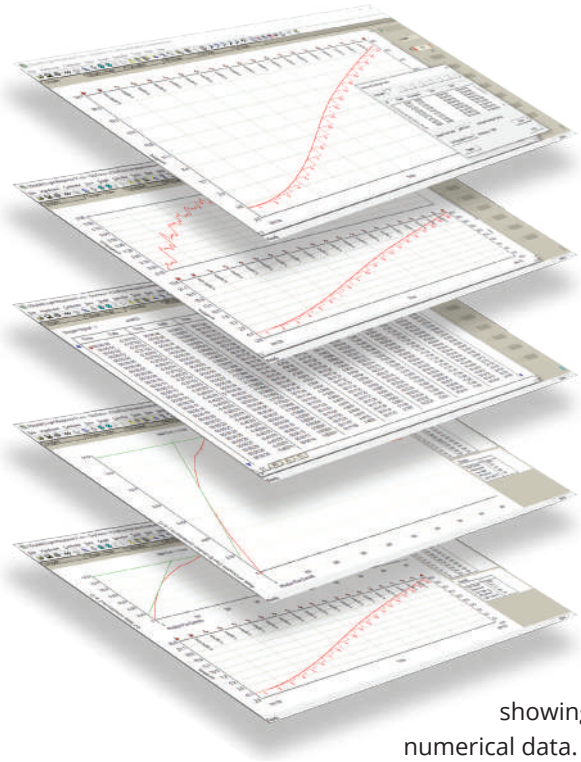
The LH36/2R has an integral cooling fan which automatically switches on to cool the housing when the light intensity reaches a certain point. This provides stability control of the light intensity when required at higher light intensity steps. Optical feedback controls within the light housing serves to enhance the stability of the LH36/2R performance across the entire range of intensity.

The LH36/2R has a peak wavelength centred at 660nm with a maximum intensity of 750 µmol m^{-2} s^{-1} in LD2/3.

QSRED quantum sensor

The QSRED quantum sensor consists of a handheld display unit and matched cosine corrected sensor head containing a special high grade photocell filtered for the 550 – 750nm waveband. The µmol m^{-2} s^{-1} value from the sensor is displayed on the LCD display. 3 measurement ranges allow maximum sensitivity from 0 – 2000 µmol m^{-2} s^{-1}.

QSRED is supplied with the Leaflab 2+ system to assist with effective calibration of the LH36/2R light housing. Each unit is supplied with an individual certificate showing that system calibration has been carried out against a National Physical Laboratory (NPL) calibrated reference lamp.



OxyTrace+ software

OxyTrace+ is a multi-function Windows® program supplied with Leaflab 2+ for system configuration, calibration, data acquisition and analysis. An automated 3 step calibration routine guides the user quickly and effectively through the system calibration process using electrode values measured from ambient air, ambient +/- 1ml of injected/removed ambient air and a further measurement of ambient air.

OxyTrace+ allows simple configuration of comprehensive PFD tables consisting of up to 20 individual light steps. Light intensity adjustments are performed automatically during the measurement. OxyTrace+ also allows calibration of the LH36/2R light source from a simple software routine. This requires manual input of measured values at each individual calibration intensity step using the QSRED quantum sensor..

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. Additional analysis tools automatically calculate rates of change for defined PFD light steps with a calculation of quantum yield presented at the end of a measurement. All files are saved as 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

Leaflab 2+ systems are supplied with the following components:

- OXYL1+: Oxylab+ electrode control unit
- LD2/3: Oxygen electrode chamber
- S1: Oxygen electrode disc and SMB-SMB connection cable
- LH36/2R: LED light housing
- QSRED: Quantum sensor
- A2: Membrane applicator to assist with smooth application of electrode membrane
- S4: PTFE membrane (0.0125mm x 25mm x 33m)
- S9B: Set of replacement o-rings for LD2/3 electrode chamber
- S14: Set of sample supports for LD2/3 electrode chamber
- S15: Set of 3-way gas taps and disposable syringes for LD2/3 electrode chamber
- S16: Cleaning kit for the S1 electrode disc.

Technical specifications

Oxylab+ electrode control unit

Measuring range:	Oxygen: 0 - 100%, pH: 0 - 14pH, Aux: 0 - 4.096V
Signal inputs:	S1 O_2 electrode (SMB), pH/ISE (BNC), Aux (8 pin Mini Din), QTP1 PAR/Temp probe (6 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
Display:	61 x 2 character blue LCD
Communications:	USB2.0
Analogue output:	0 - 4.5V O_2 signal
Dimensions (HWD):	250 x 125 x 65mm - 0.63 Kg
Power:	95 - 260V universal input mains supply. Output 12V DC 2.5A

LD2/3 electrode chamber

Suitability:	Gas-phase photosynthesis/ respiration
Construction:	Black acetal
Sample Chamber:	Leaf chamber (7.5cc)
Sample Area:	10cm^2
Optical Ports:	Cast acrylic top window, optical port (16mm dia) and fluorimetry port for FMS1 & 2 modulated fluorimeters
Temperature Control:	Double water jacket connected to circulating water bath
Dimensions (w x h):	100mm (d) x 130mm (h) - 650g

S1 oxygen electrode disc

Electrode type:	Clark type polarographic sensor
Electrode output:	Typically 1.6µA at 21% O_2
Residual current:	Typically 0.04µA in 0% O_2
Response time:	10 - 90% typically < 5 seconds
Oxygen consumption:	Typically <0.015µmol/hr^{-1}

LH36/2R light source

Light source:	36 red LED array
Control:	Via Oxylab+ & OxyTrace+ software
Wavelength:	660nm peak wavelength
Cooling:	Integral automatic cooling fan
Intensity:	max. 750 µmols m^{-2} s^{-1}
Dimensions:	74 x 52mm - 270g

QSRED quantum sensor

Measuring Range:	0 - 2000 µmolm^{-2} s^{-1} in 3 ranges (0 - 20.00, 0 - 200.0, 0 - 2000) in the 550 - 750nm waveband
Resolution:	1 µmol m^{-2} s^{-1} at 0 - 2000 0.1 µmol m^{-2} s^{-1} at 0 - 200.0 0.01 µmol m^{-2} s^{-1} at 0 - 20.00
PAR Sensor:	Silicon photodiode/optical filter combination with white acetal diffuser (37mm dia)
Signal Display:	Handheld display unit with LCD. 0 - 2V analogue output of measured values
Power Requirement:	1 x 9V PP3 cell
Dimensions Display:	146 (h) x 78 (w) x 35mm (d)
Weight:	238g (including battery).

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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