



Product Catalog

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CIRAS-2 Portable Photosynthesis System

Leaf Gas Exchange For Research

The CIRAS-2 is considered by many scientists to be the "benchmark" gas exchange system for field use. All features are fully integrated into a field portable, lightweight package. The system has a high technical specification, yet is robust and reliable. With the chlorophyll fluorescence module and control software, it is also a versatile and effective laboratory system for the most demanding application. A wide range of cuvettes and chambers are available for leaf, canopy and soil studies, spot measurements or analysis of long term changes in gas flux. The CIRAS analyzers are protected in a temperature controlled enclosure within the console to ensure measurement stability under the normal range of ambient conditions. The design of the CIRAS-2 ensures an inherent calibration stability which has been confirmed by many years experience of the technology employed.

Automatic Environment Control

CO₂ & H₂O

The CIRAS-2 system features automatic control of CO₂ and H₂O as standard. Our unique gas mixing system is integrated into the main console and provides independent, accurate and automatic control of both CO₂ and H₂O. CO₂ control is provided by use of mini CO₂ cartridges which can easily be swapped in and out regardless of the state of charge. Measurements under ambient CO₂ and H₂O conditions are also available to the end user if required.

Control Range

CO₂: 0-2,000 $\mu\text{mol mol}^{-1}$

H₂O: 0-Dewpoint

Temperature

Integrated into the automatic leaf cuvettes, with the option of either setpoint control or tracking of ambient.

Control Range

-8° C below ambient to +40° C

Light

Optional light sources based on LED's or quartz halogen bulbs.

Control Range

0-2,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$

Refer to leaf cuvette section for more information.



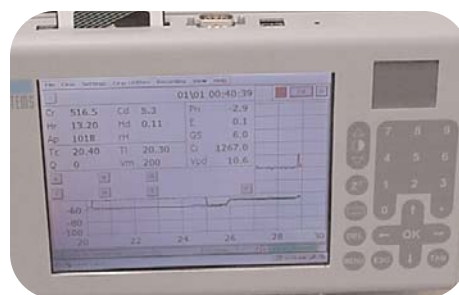
Features

- Lightweight and truly field portable
- NiMH batteries provide for full day typical operation
- Simultaneous measurement of photosynthesis & chlorophyll fluorescence (with optional CFM)
- Open & closed system measurements
- Automatic control of CO₂, H₂O, temperature & light
- Auto-Zero and self-calibration features
- Wide range of standard cuvettes and light units for single leaves, canopies and soil analysis
- Shoulder harness for hands-free operation



Powerful User Interface & Software

The CIRAS-2 system is ideal for performing automatic response curves (i.e. A/Ci, light, temperature) in the field or lab. The main console features a user interface that includes a large, color display that is optimized for use in the field. The system can display **15 measurement parameters and graphics simultaneously in real time**. Powerful and intuitive system software ensures user friendly operation even for the most inexperienced user. In addition, the same software can be used to control the CIRAS-2 remotely from your PC.



Chlorophyll Fluorescence Module (CFM)

The Chlorophyll Fluorescence Module (CFM), developed in cooperation with Hansatech Instruments, provides measurement of chlorophyll fluorescence using the pulse amplitude modulation (PAM) technique. The CFM easily attaches to the PLC6 (U) Automatic Universal Leaf Cuvette with the signal conditioning board integrated into the CIRAS-2 main console. The CIRAS-2 User Interface provides powerful software control and programmable automation of the measurements permitting fully integrated gas exchange & chlorophyll fluorescence data to be simultaneously collected, displayed and saved as a single record. The user has full control over all light intensities and durations, modulating beam levels and fluorescence detector gain.



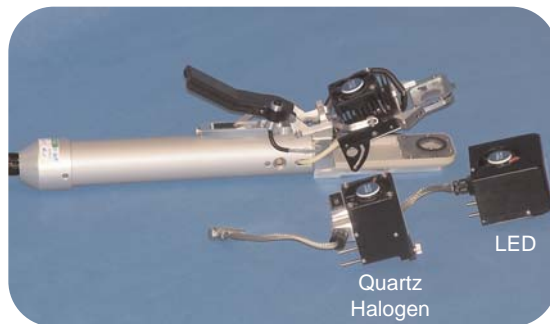
The key fluorescence parameters measured and calculated include: F₀, F_m, F_v, F_v/F_m (Max Yield), F_s, F_m' , F_o' , ϕPSII or $\Delta\text{F}/\text{F}_m'$ (Yield), qP, qNP, NPQ, PAR, TEMP and ETR.



PLC6 (U) Automatic Universal Leaf Cuvette

The PLC6 (U) Automatic Universal Leaf Cuvette is lightweight and robust making it ideal for rapid sampling of leaf gas exchange in the field as well as for laboratory studies. It features integral peltier cooling elements for accurate, automatic control of leaf cuvette temperature. Our unique head design allows the user to customize the cuvette area to meet specific applications and plant types. Three chamber inserts with window areas of 25mm x 18mm, 25mm x 7mm and 18mm are standard. Custom inserts are also available upon request. A recording button is conveniently located on the handle ensuring easy recording of photosynthesis data with just one hand.

Accurate, non-contact leaf temperature measurement and control is ensured by a built-in IR sensor that is fitted to the base of the cuvette. Two PAR sensors are located inside the cuvette at the leaf surface for accurate measurement of PAR (Photosynthetically Active Radiation).



Leaf Gas Exchange

Temperature

Automatic temperature control is integral to the PLC6 (U) Automatic Universal Leaf Cuvette. The user can easily control temperature over a wide range with an option to track ambient.

Control Range

-8° C below ambient to +40° C

Light

We offer 2 light sources for use with the PLC6 (U) featuring automatic control of light. Our LED light source features a bank of red and white LED's and requires minimal power to operate. The white LED's are included to improve spectral distribution. A fan-cooled, quartz halogen light source offers excellent spectral distribution throughout the PAR range (but has a higher power requirement).

Control Range

0-2,000 $\mu\text{mol m}^{-2} \text{s}^{-1}$

TPS-2 Portable Photosynthesis System

Features

- Lightweight & field portable
- Accurate CO₂ and H₂O measurement
- Adjustable CO₂, H₂O and light for response curves
- Simple, user-friendly operation
- Full data logging and storage capability
- RS232 output for data transfer to PC

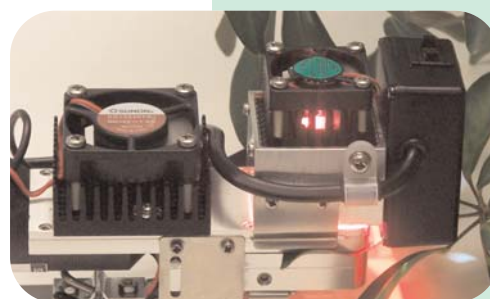


The TPS-2 is supplied with a custom designed carrying case and shoulder strap making field measurements simple and easy.



The TPS-2 system is an ideal choice for teaching and basic research. In addition to measurements at ambient conditions, the user can control CO₂, H₂O and light for response curves.

An optional LED light unit is available for control of cuvette light intensity.



Leaf Gas Exchange For Teaching & Basic Research

Our success and expertise in leaf gas exchange systems led to the development of the TPS-2 Portable Photosynthesis System. The TPS-2 is a low cost system with very good technical specification for measurement of leaf gas exchange in the laboratory or field. The TPS-2 system is a completely self-contained instrument with all the necessary pumps, flowmeters, valves, cuvette and light unit (optional) for measurement on a wide variety of plant types.

Leaf Cuvettes And Accessories

For over 20 years, PP Systems has been producing a full range of leaf cuvettes to accommodate a wide variety of leaf types (broad, narrow, conifers, pods, fruits, etc.). In addition, our technical staff have produced many special designs for specific applications and plant types such as mosses, lichens, *Arabidopsis*, Cactii.

We offer a range of low cost, "manual" style cuvettes and light units for leaf gas exchange measurements under ambient conditions. We also offer an extensive range of "automatic" leaf cuvettes that feature integrated, automatic control of temperature from approximately -8° C below ambient up to +40° C. Optional light units are available for use with all "automatic" style leaf cuvettes providing automatic, integral light control. All "automatic" style cuvettes can be used for ambient studies as well.



Conifers, needles (PLC5-C)



Grasses, cereal crops (PLC5-N)



Arabidopsis and other low lying vegetation (PLC6-A)



Mosses, lichens



Custom chambers

Adapters are also available to allow cuvettes and chambers to be used with both CIRAS-1 and CIRAS-2.

Custom chambers are also available upon request.

Soil & Canopy Chambers

PP Systems offers chambers for both open (long term, unattended monitoring) and closed system (rapid, short term monitoring) chambers for measurement of soil and net canopy CO₂ flux. Our CIRAS analyzers can be used with both open and closed chambers and have the required software to calculate rates of assimilation/respiration and evaporation. All open system chambers require a separate air supply with adjustable flow rates. This is provided by the Control Interface Module (CIM). A range of chamber sizes are available, including flexible polythene and PET (Polyethylene terephthalate) models with an adjustable height. Stainless steel base rings are available for fixed sites. The chambers are lightweight, quick to install and easy to set up. An optional soil temperature probe (CFX or STP) is available for use with both open and closed system chambers.

For stand-alone measurements, all of our open chambers can be used with our Control Interface Module with integral analyzer (See CO₂ Gas Analysis on page 6).



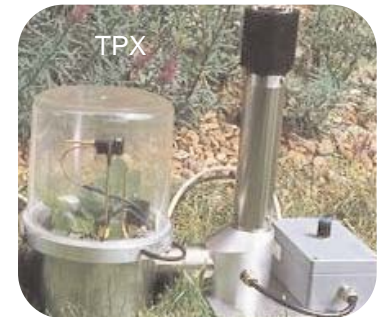
SRC-1 Soil Respiration Chamber (Closed)



CFX-2 Soil Respiration Chamber (Open)



CPY-2 Canopy Assimilation Chamber (Closed)



CPY-3 Canopy Assimilation Chamber with Control Interface Module (Air Supply)



CPY-3 Canopy Assimilation Chambers (PET)



CPY-3 Canopy Assimilation Chamber (Polythene)

Steady State Porometer

Features

- Lightweight & field portable
- Steady state system
- Ergonomic leaf cuvette
- Multipurpose, with CO₂ analyzer
- Full datalogging & storage capability
- User friendly



The PMR-5 is lightweight, field portable and supplied with a shoulder strap making field measurements simple and easy.



There is continuous calculation and display of the reference and chamber humidity, leaf temperature (energy balance), airflow rate, incident PAR (Photosynthetically Active Radiation) and stomatal conductance. The transpiration rate is also recorded.

Software is supplied to allow the transfer of data (ASCII) from the instrument to your PC.

The PMR-5 is a steady-state, continuous flow porometer designed to be used with our popular EGM-4 CO₂ analyzer. The EGM-4 supplies the power (internal, rechargeable 12V battery), measures the outputs from the porometer sensors, processes the results and then displays and records the data. The PMR-5 is a hand-held unit using an "open system" measurement of leaf transpiration. The lightweight cuvette is designed to couple the leaf to the ambient temperature using a fan, heat sink and radiation shield.

There is a stirring fan in the chamber to minimize the boundary layer resistance. Digital humidity and temperature sensors accurately monitor the air entering and leaving the cuvette. The chamber is designed to minimize the temperature difference between sensors. A sensor matching process eliminates errors due to sensor imbalance.

CO₂/H₂O Gas Analysis

Our laboratory CO₂ and H₂O infrared gas analyzers are based on the popular CIRAS differential CO₂/H₂O gas analyzer originally developed for photosynthesis and transpiration measurements on plants. All CIRAS analyzers feature a very high technical specification and quality workmanship ensuring accuracy, precision and reliability. Designed to be operated through a standard PC, with integral logging for stand-alone operation.

Features

- High precision, non-dispersive infrared gas analyzers for CO₂ and H₂O
- CO₂ Range: 0-2,000 ppm (up to 9,999 ppm)
- Fast response
- Analog & digital (RS232) linear output
- Excellent stability achieved by built-in auto-zero facility
- Fully compensated for changes in temperature, pressure and gas interactions
- Built-in sampling pump with mass flow controllers
- Insensitive to vibration, no moving parts ensuring high reliability
- Integral datalogger with 5 analog and 2 thermistor temperature inputs



The **CIRAS-SC** is a single channel, absolute CO₂/H₂O infrared gas analyzer for accurate measurement of a single gas stream.

Applications

- Plant/Crop physiology
- Atmosphere & pollution CO₂ monitoring
- CO₂ enrichment studies
- Animal/insect physiology
- Industrial process control



The **CIRAS-DC** is a dual channel, true differential system featuring 4 independent infrared gas analyzers (2 for CO₂ and 2 for H₂O). As such, it is capable of resolving small differences between two gas streams in real time.

This type of instrument (true differential analyzer) is the preferred option for plant photosynthesis and respiration measurements where differential concentrations need to be resolved to a high degree of accuracy and precision.

For users that demand a high level research CO₂/H₂O analyzer

CO₂ Gas Analysis

PP Systems specializes in the design and manufacture of infrared gas analyzers (IRGA's). These instruments are single channel, absolute CO₂ analyzers for measurement of a single gas stream. They are based on a standard module (**SBA-4**) which employs a non-dispersive measurement technique, coupled with microprocessor based signal processing to achieve good stability and specificity to CO₂. All gas analyzers are fully compensated for temperature and pressure. Fast warm-up, adaptation to changing ambient conditions and excellent stability is achieved by automatic resetting of the analyzer zero at regular intervals (Auto-Zero). Normal operation of the analyzers requires a continuous flow of the sample gas. However, static measurements are available with the **SBA-4** and **EGM-4** enabling the use of aerosol calibration mixtures as well as the injection of syringe samples. A **Control Interface Module (CIM)** with integral CO₂ analyzer (optional humidity sensor) is also available. It includes a suitable air supply unit required for stand-alone measurement of "Open" system soil and net canopy flux.

All analyzers feature an analog output making them compatible with industry standard PID controllers when CO₂ control is required. In addition, all analyzers feature a 4-20 mA current output and digital (RS232) output for transfer of data in ASCII format.

Standard Ranges

- 0-1,000 ppm (0.1 %)
- 0-2,000 ppm (0.2 %)
- 0-5,000 ppm (0.5 %)
- 0-10,000 ppm (1.0 %)
- 0-20,000 ppm (2.0 %)

Higher ranges up to 100,000 ppm (10%) available upon request.

Optional Humidity Sensor

A digital humidity sensor can be fitted to all gas analyzers to accurately measure humidity of the gas stream in addition to CO₂ concentration. The measurements are expressed as H₂O vapor pressure (mb).

SBA-4 OEM CO₂ Analyzer

Accurate, compact, low cost optical bench for incorporation into users existing systems.

- Integration into environmental control systems & greenhouses
- Plant & animal science
- Oceanography
- Industrial process monitoring & control

It requires only a power supply, pump and absorber to complete the system.



WMA-4 CO₂ Analyzer

Ideal for fixed installations. This unit has a built-in, long life sampling pump and can be powered by mains (115/230V AC) or 12V DC (for use in the field).

- Growth cabinets
- Environmental control rooms & greenhouses
- Fruit Storage
- Breweries
- Industrial process monitoring & control



An optional 2 channel version of the WMA-4 is also available.

EGM-4 Environmental Gas Monitor for CO₂

This compact portable unit is powered by an internal rechargeable battery and includes a built-in, long life sampling pump. Ideal for both lab and field applications.

- Environmental monitoring
- Animal Physiology
- Borehole monitoring/depth profiling
- Soil CO₂ flux measurements (see page 4)



Control Interface Module (CIM)

The CIM provides a controlled supply of ambient air, with optional integral CO₂ and humidity analyzer. It is designed for use with our range of CPY-3 open system canopy chambers (see page 4) for unattended, long term measurement of soil and canopy flux. The optional analyzer features a built-in display, keypad and datalogger that is protected inside a water resistant enclosure.



Environmental Probes - A range of probes are available for use with our gas analyzers including:

Oxygen



Temperature/PAR



PAR

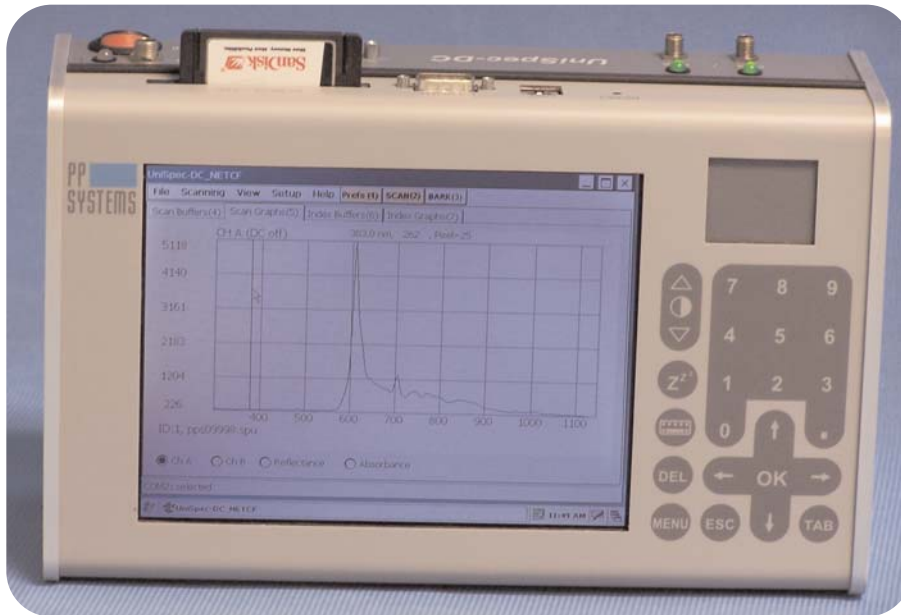


Leaf Reflectance And Remote Sensing

Single and dual detector systems for vegetation reflectance and field remote sensing applications.

The **UniSpec-DC** is a dual channel, field portable instrument capable of unattended, simultaneous measurement of incident and reflected light. It allows sampling under any sky conditions, including clouds. Recent studies have shown that narrow band spectral indices can track diurnal and seasonal trends in both leaf to stand-level photosynthetic activity and can detect periods of photosynthetic downregulation due to water, nutrient and temperature stress. Additional studies suggest that thermal bands, particularly when combined with optical remote sensing, may be able to provide additional information on the degree of photosynthetic downregulation under water stress. Perhaps even more significant is the possibility that the controls on respiratory carbon flux can also be revealed through a combination of remote sensing tools that includes the **UniSpec-DC**.

The **UniSpec-SC**, commonly referred to as a "Reflectometer", is a single channel, field portable instrument designed for measurement of leaf reflectance. It features a built-in light source and extensive range of accessories for measurement on a wide variety of leaves (including needles). In addition to revealing dynamic features related to the physiological condition of vegetation, spectral reflectance can also be used to derive basic information about leaf or canopy structure, nutritional status and pigment content. Leaf chlorophyll content and nitrogen status are both indicators of integrated leaf physiology. As "health" and photosynthetic performance decline with stress or age, tissue nitrogen and chlorophyll content also decline. Both chlorophyll and nitrogen content can be readily estimated from empirically calibrated estimates of leaf reflectance.



Common System Features

- Lightweight, field portable instruments
- High precision detectors (310-1,100 nm)
 - Other ranges available upon request
- Powerful user interface/software
- Extensive range of accessories (FOV lens, fiberoptics, cosine head, etc.)

UniSpec-DC Applications:

- Remote sensing (aircraft, UAVs, flux towers, trams, blimps, etc.)
- Ground truthing
- Automated optical sampling
- Plant Ecophysiology

The main console features a user interface that includes a large, color display that is optimized for use in the field.

User Interface Features

- Large, color reflective display
- Powerful yet user friendly software
- Graphical & numerical display of data

UniSpec-SC Applications

- Plant Physiology & Ecology
- Field crop monitoring
- Screening plant populations
- Remote sensing/ground truthing
- Oceanography



The UniSpec-DC mounted on a tram based system for unattended, automated optical sampling along a transect



Measurement of leaf level reflectance in the field with UniSpec-SC, bifurcated fiberoptic and leaf clip



The UniSpec-DC can be used on flux towers for remote sensing of vegetation

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About PP Systems

PP Systems is a small company that specializes in the design and manufacture of scientific instrumentation for the plant and soil sciences. For over 20 years, we have provided high level sales and technical support to thousands of researchers in over 100 countries worldwide. Our instrumentation is well documented and referenced in many prestigious scientific publications and journals and supported by highly trained staff and a large network of factory trained distributors offering local training and technical support.

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