

# OceanPack™ RACK MK-3

Analyzer: LI-7200x

Modular flow-through underway system

for precise  $p\text{CO}_2$  measurements

**LI-COR**  
Biosciences inside



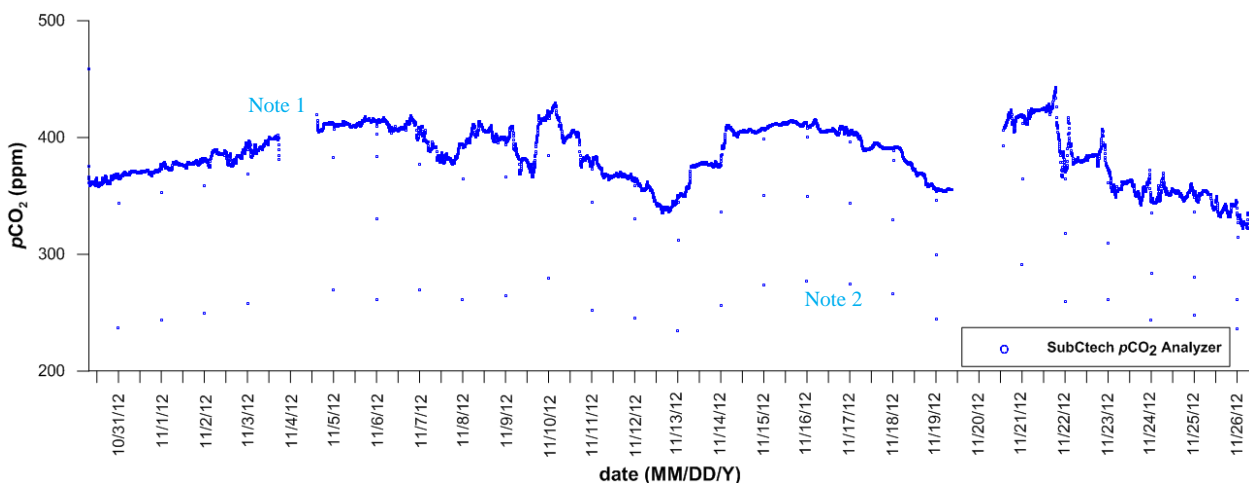
- Reference LI-COR® analyzer
- Auto calibration
- Lowest maintenance
- Roughest environmental
- High precision
- Low investment
- Operates on small vessels
- Top-Box contains optionally Sensors or GPS

## Features & Benefits:

- It's a LI-COR® Biosciences LI-7200x  $p\text{CO}_2$  sensor: Highest accuracy due to automatic temperature, pressure and  $\text{H}_2\text{O}$  compensation
- Robust, versatile and compact housing for offshore and laboratory applications
- Hand-held, easy to operate and maintain system with intuitive overall design. High time series stability due to obligatory standard offset zeroing. Optional auto- or manual span gas calibration supported. Low maintenance costs!
- AUMS (Autonomous Underway Measurement System) concept: easy instrument integration through integrated data logger: e.g. Aanderaa Oxygen Optode; TriOS, Turner or WET Labs Fluorometer and Turbidity sensor; Seabird or Sea&Sun CTD and Thermosalinograph; SYSTEAN nutrient analyzer
- Connection of external devices through RS-485 bus possible, e.g. meteorology sensors or sea- and waste water pumps. A full water supply is supported.
- Optional automatic cleaning procedure including flagging of collected data
- Automatic report of interferences and initiation of diagnostic routines
- Optional GPS geo references for all data and position event control
- Optional online telemetry data transfer and alarm services



Specification	<i>p</i> CO <sub>2</sub> sensor unit
<b>Sensor Principle</b>	High performance <b>LI-COR</b> ® LI-7200x analyzer – special produced by LI-COR® Biosciences for SubCtech - contains NDIR detector for CO <sub>2</sub> and H <sub>2</sub> O filtered by an optical chopper filter wheel <ul style="list-style-type: none"> <li>• Silicone flat membrane equilibrator</li> </ul>
<b>Range</b>	Standard 0...3000 ppm CO <sub>2</sub> • 0...60 ppt H <sub>2</sub> O • Units selectable ppm, µmol/l, µAtm
<b>Resolution</b>	0.01 ppm CO <sub>2</sub> • 0.0001 ppt H <sub>2</sub> O
<b>Accuracy</b>	Minimized drift • Correction for water vapour, pressure and temperature effects • uncorrected noise < 0.08ppm (5Hz output rate) • overall accuracy < 1% FS
<b>Sample Rate</b>	Output rate typ. 1 Hz with average user configurable • Eddy covariance methods supported • Storage rate configurable
<b>Calibration</b>	Calibration stored internally • Recalibration recommended every 12 months • Factory calibration with 15 traceable gases to WMO standards for CO <sub>2</sub> . NIST traceable LI-610 portable dew point generator for H <sub>2</sub> O • User correction supported
<b>Auto Calibration</b>	Auto offset zeroing check on programmed intervals • Zeroing reference included for >1 year operation time • Auto span gas calibration supported (2 standard gases)
<b>Service</b>	Recalibration & Service recommended every 12 months • Membrane lifetime up to 10years • Operating time for 24/7 usage typ. 1 year before service (internal micro pump, zero filter)
<b>Air pCO<sub>2</sub></b>	Optionally air inlets can be provided by using the same analyzer • The Top-Box with its own independent analyzer can be installed on deck – no tubes are needed in this case • Top-Box design allows the connection of meteorological sensors.



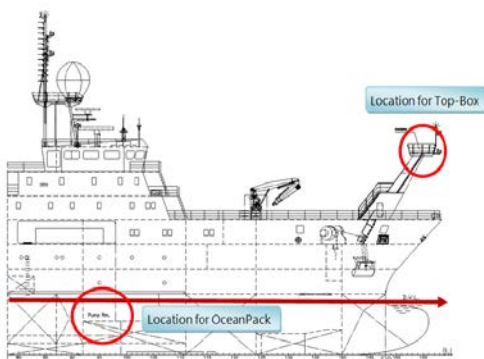
3 weeks raw data on board RV POLARSTERN between Bremerhaven (Germany) and Cap town (South Africa) in November 2012.

Note 1: measurement stopped during shutting down the sea water pump

Note 2: single marker points represents the auto-zeroing



Specification	Flow-Through (underway) system
<b>Housing</b>	19" Industrial rack HE • Open side doors for maintenance • Front splash protected • Sensor unit IP66 • Consists of <b>LI-COR®</b> Sensor Unit and data logger • All tubes and connectors can be handled from the front
<b>Weight</b>	55 kg without optional sensors or pumps
<b>Size</b>	600 x 830 x 600 mm W x H x D (pCO <sub>2</sub> sensor, Debubbler, SBE-45 TSG)
<b>Water Support</b>	Integrated flow-through system • access from all sides • ideal for ship applications • optionally <b>mBubbler®</b> : CO <sub>2</sub> tolerant Debubbler • optionally external inlet and outlet tanks • flow rate typ. 5 l/min • max. water pressure 3 Bar
<b>Analogue</b>	0...5V / 4...20mA • Range and full-scale can be configured
<b>Data Interface</b>	RS-232C • Option RS-485 • ASCII NMEA-0183 • Easy integration into existing systems • Ethernet • Data and Backup on 2GB CF card
<b>External Sensors</b>	Example of optionally external sensors: SYSTEA nutrient analyzers • Water sampler • GPS Receiver • FSI sensors • Sea&Sun CTD probes • Seapoint optical sensors • bbe MOLDAENKE algae online analyzer • RDI • Aanderaa Optode and sensors • Seabird – e.g. SBE45 Thermosalinograph • external Top-Box meteorological instrumentation via RS-485 bus
<b>Cleaning</b>	Optionally integrated self-cleaning available • Flagging of the data for maintenance and error states • Cleaning (anti-fouling) for integrated sensors optionally provided
<b>Controller Unit</b>	Touch-panel controller • Automatic messages for failures and diagnostic messages • 2 GB CompactFlash for system and data storage • Programmable Soft-PLC (Programmable Logic Controller) • Expandable via RS485 modules for pumps, valves etc.
<b>Analogue Input</b>	Optionally 24 Bit data acquisition 0/4-20 mA, ±10V etc. • Expandable via RS485 Bus for e.g. meteorology or in-situ measuring devices.
<b>Power</b>	10..32 VDC or 90..240 VAC • typ. 45W (without external pumps)



Sea-Air-Exchange "Underway" System

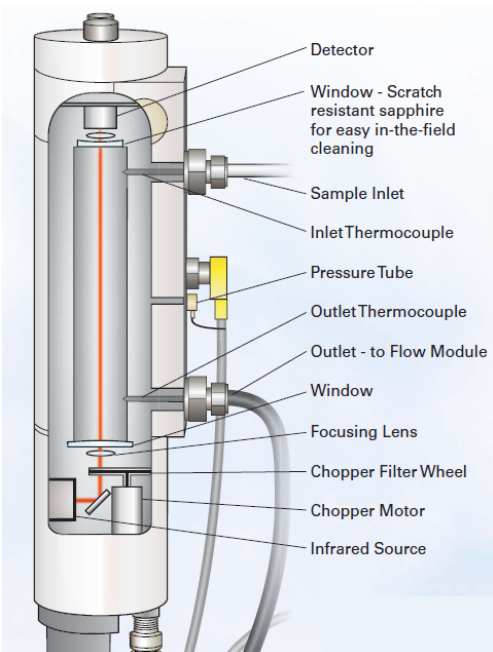
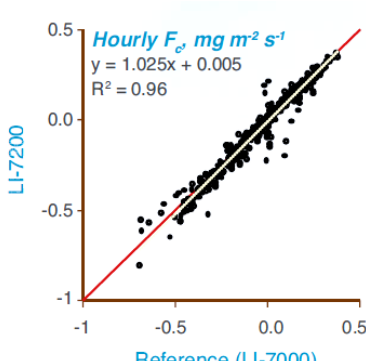
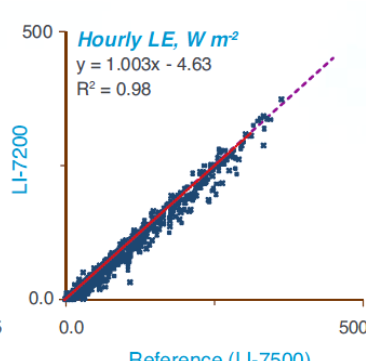


Complete "FerryBox" AUMS System



OceanView™ DataServer



Specification	How it works
<p><b>In general</b></p>	<p>The LI-7200x features a simple, user-cleanable optical bench. It can be cleaned on site without any special tools and without removing the instrument from the platform. To open the optics for cleaning, simply loosen the two knurled screws on the top of the analyzer, lift the analyzer cap, and slide out the optical path. There is no need for factory recalibration after cleaning the optical components, and there are no delicate optical components to re-align. The optical path thermocouples and pressure transducer are protected in the optical path to minimize the risk of damage during cleaning.</p>
<p><b>In detail</b></p>	<div style="display: flex; align-items: flex-start;"> <div style="flex: 1;"> <p>The LI-7200x sensor head has enclosed optical cell, with single pass optics and a large 8mm diameter optical beam. Optical filters centered at 3.95<math>\mu</math>m and 4.26<math>\mu</math>m provides reference and absorption signals for CO<sub>2</sub>, while filters centered at 2.35<math>\mu</math>m and 2.59<math>\mu</math>m provide reference and absorption signals for water vapour.</p> <p>The figure to the right shows a cutaway representation of the LI-7200 sensor head. The Infrared Source emits radiation, which is directed through a Chopper Filter Wheel, Focusing Lens, and then through the measurement path to a temperature-controlled lead selenide Detector. A brushless Chopper Motor rotates the Chopper Filter Wheel at 9,000rpm. Lifetimes of the source, detector, and chopper motor are extremely long – in a ten-year period, over 96% of instruments have never had these repairs done. The Windows at both ends of the optical path are made of scratch resistant sapphire, allowing for worry-free cleaning in the field. (Image &amp; Text © LI-COR®)</p> </div> <div style="flex: 1;">  </div> </div>
<p>The figures to the left show hourly CO<sub>2</sub> and H<sub>2</sub>O fluxes measured with the LI-7200 Enclosed Analyzer compared to fluxes measured with the LI-7000 and LI-7500 analyzers, which were used as standards. Fluxes measured with the LI-7200 were within 2.5% of the standards for all field experiments. These data were collected in 3 deployments that took place over four seasons. (Image &amp; Text © LI-COR®)</p>	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;">  <p>Hourly <math>F_c</math>, <math>mg\ m^{-2}\ s^{-1}</math>  <math>y = 1.025x + 0.005</math>  <math>R^2 = 0.96</math></p> </div> <div style="text-align: center;">  <p>Hourly LE, <math>W\ m^{-2}</math>  <math>y = 1.003x - 4.63</math>  <math>R^2 = 0.98</math></p> </div> </div>

