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GASSYS3 O_2 & CO_2 GAS ANALYSIS SYSTEM

Flexible Data Display & Reporting - VO_2, VCO_2, RER, RMR, EE, REE

GASSYS3 Gas Analysis System—paired with the BIOPAC MP36 unit, SS11LB airflow transducer, and accessories—provides a lower-cost, compact, simpler, solution suitable for both education and research physiology applications. Obtain quality metabolic data, such as Volume of Oxygen Consumed ($\dot{V}O_2$), Volume of Carbon Dioxide eliminated ($\dot{V}CO_2$), Respiratory Exchange Ratio (RER), Energy Expenditure (EE, REE) and Resting Metabolic Rate (RMR) from Subjects at rest or during exercise.

GASSYS3 solves a myriad of challenges traditional methods of obtaining metabolic data often present, including high cost, extensive, complex and costly calibration requirements, and difficult operation.

- O_2 and CO_2 sensors
- 5-Liter Mixing Chamber
- Relative Humidity Sensors—ambient and chamber
- Temperature Sensors—ambient and chamber
- Barometric Sensor—ambient
- Fits Standard 35 mm Tubing
- Small and Compact Unit
- Automated Setup and Analysis
- Requires Less Frequent Gas Calibration

The BIOPAC GASSYS3 provides detailed insights on human subjects' responses in a variety of research applications, such as exercise physiology, sports science, biomedical engineering, psychophysiology, and many product development and consumer neuroscience applications.

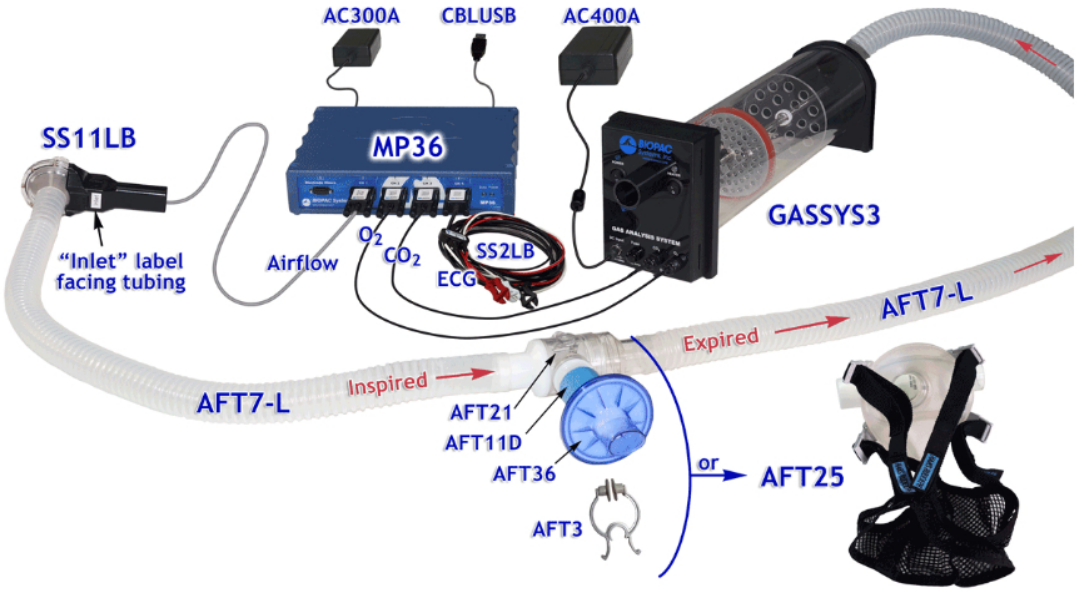
- CO_2 sensor range extended from 5% to 10%, important for VO_2 Max measurements.
- Integrated heater lowers the relative humidity to prevent condensation from forming in and around the sensors.
- Integrated environmental sensors for both ambient and chamber air. These sensors are read in serially by the MP36 (under software control) and are used to adjust measurements based on changes in temperature, relative humidity, and barometric pressure.
- Small blower inside chamber, which helps mix the air, improves CO_2 sensor response time and helps prevent condensation inside the CO_2 sensor.
- Sealed Chamber prevents ambient air from corrupting the chamber air between expired air cycles.
- New design results in less air restriction.
- Auto-voltage calibration and memory circuitry added to the O_2 and CO_2 circuits to improve accuracy.

Measure Expired O_2 and CO_2 Concentrations

Required Equipment

- **GASSYS3** with included Power Supply (12V, 5A) with choice of cord (US, EU, China)
  - *optional*: Calibration Kit GASKIT3
- **MP36** with BSL 4.1.3 or above OR **MP36R** with Acq*Knowledge* 5.0.3 or above; not compatible with MP46/45.
- **Airflow Transducer** SS11B
- **T-Valve**
  - *option 1*: high flow T-valve (AFT21 35 mm OD) + Disposable filter with mouthpiece (AFT36) + Disposable Nose Clip (AFT 3).
  - *option 2*: Facemask with integrated T-valve (AFT25) + Syringe coupler, 35 mm to 25 mm (AFT11A).
  - *option 3*: low flow non-rebreathing T-valve (AFT22) + smooth bore tubing (AFT7-L) + flexible coupler (AFT11E).
- **Calibration syringe**—required to flush the chamber during setup if not performing gas calibration.
  - *option 1*: AFT27 3 L calibration syringe or equivalent 2, 3, 5- or 7-liter syringe.
  - *option 2*: soon to be released GASKIT3 calibration kit, which will include an AFT27.
- **Airflow & Gas Analysis Accessories**
  Choose AFT Series tubing, couplers, etc. accessories to suit your protocol.

Setup



GASSYS3 Example Setup

Notes

- The non-rebreathing "T" valve directs only expired air to the GASSYS3. The mixing chamber inside the GASSYS3 averages respiratory outflows. This averaging effect causes the CO_2 and O_2 concentrations to vary in accordance with the mean values resident in multiple expired breaths.
  - For resting measurements, the airflow transducer can be placed on the output port of the GASSYS3.
  - For exercise measurements, the airflow transducer is placed on the inspired side of the T-valve to reduce the chance of condensation affecting airflow accuracy. The transducer should be held securely (i.e., stabilized on a tripod) to reduce vibration.

- When the subject inspires, air will be drawn into the GASSYS3 through the SS11LB air flow transducer, which is placed on the inspiration side to eliminate any effects associated with expired air humidity.
- When the subject expires, air will be directed to the GASSYS3 module, which is designed to work with saturated expired air.

Recording Procedure

See BSL *PRO* Lesson procedures:

- H19 VO2 & RER
- H29 Basal Metabolic Rate

Citations

These Gas Analysis System Citations used BIOPAC's previous Gas Analysis System GASSYS2—the new GASSYS3 can be used in place of the older GASSYS2 for these and other protocols.

GASSYS3 Sensor Element Specifications

1. **Sensor Type:** O_2 - **Fujikura (FCX-UC)**

   Range: 0.1 – 25% O_2
   Temp. Range: -10° – 50° C (14° – 121° F)
   Relative Humidity Range: 0 – 85% (non-condensing)
   Accuracy: +- 0.5% O_2
   Response Time: within 30 seconds (90% of value)
   Warm-up time: <= 1 minute
   Life expectancy: 3 years (continually on)
   Operation: Limiting current method using Zirconia Solid Electrolyte

2. **Sensor Type:** CO_2 – **SenseAir K-30**

   Range: 0 – 10% CO_2
   Temp. Range: 0° – 50° C (32° – 122° F)
   Humidity Range: 0 – 95% (non-condensing)
   Accuracy: +- 0.5% O_2
   Response Time: within 20 seconds (90% of value)
   Warm-up time: <= 1 minute
   Life expectancy: 15 years (continually on)
   Operation: Non-dispersive infrared (NDIR) waveguide

3. **Sensor Type:** Digital (I2C) Temperature, R.H. and Barometric Pressure **– Bosch BME280**

   Used for Ambient Air sensing.
   Operational Temperature range: -40° - 85° C (-40° – 185° F)
   BME280 Temperature:
   Full-accuracy Temperature range: 0° – 65° C (32° - 150° F)
   Accuracy: +- 1° C (full temp. range), +- 0.5° C (@ 25° C)
   Response Time: not stated.
   Note: Temperature value depends on PCB temperature, sensor element self-heating and is typically above ambient temperature.
   BME280 Relative Humidity:
   Range: 0 – 100% R.H

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Full accuracy temperature range: 0° – 60° C (32° - 140° F)
Range: 0 – 100 % R.H.
Accuracy: +- 3% R.H.
Response Time: 1 sec. $t_{63\%}$
Long-term stability: 0.5% R.H./year
Note: Needs some airflow (1 m/s) to meet specs.
BME280 Barometric Pressure:
Range: 225 – 825 mmHg
Full accuracy Temperature range: 0° – 65° C (32° - 150° F)
Absolute accuracy: 0.75 mmHg
Long term stability: +- 0.75 mmHg/year

4. **Sensor Type:** Digital (I2C) Temperature and R.H.– **ChipCap 2-SIP**
   Used for Chamber Air sensing.
   Operational Temperature range: -40° – 125° C (40° – 257° F)
   ChipCap Temperature:
   Range: -40° - 125° C (-40° – 257° F)
   Best accuracy (+- 0.3° C) Temperature range: 20° – 40° C (68° - 104° F)
   Good Accuracy (+- 1° C) Temperature range: 0° – 70° C (32° – 158° F)
   Response Time: 5 sec. t63%
   Long term stability: < 0.05° C/year
   ChipCap Relative Humidity:
   Range: 0 – 100% non-condensing
   Full accuracy Temperature range: 0° – 60° C (32° - 140° F)
   Accuracy: +- 2% R.H. (20 – 80% R.H.), +- 4% (0 – 100% R.H.)
   Response Time: 7 sec. $t_{63\%}$
   Long term stability: < 0.5% R.H./year
   Note: Needs some airflow (1 m/s) to meet specs.

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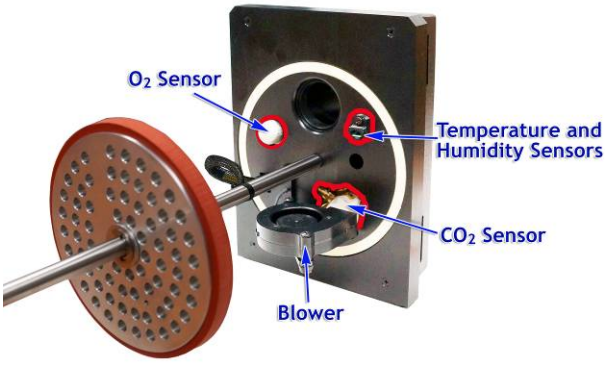
Cleaning the BIOPAC GASSYS3

> ***Note***
>
> Since the GASSYS3 processes only expired air, it is not necessary to clean using strong disinfectants such as Cidex OP. It is recommended to use 60-75% Isopropyl Alcohol in water.
>
> - Never let isopropyl alcohol get on any of the sensors.

1) Unscrew (counterclockwise) the knob on the Inlet side (see below left figure).

2) Carefully pull the Inlet Plate away from the mixing chamber. It may be necessary to gently wiggle the plate side-to-side to remove it.
3) Gently pull the clear cylinder away from the Outlet/Sensor Plate. Be careful not to rotate the cylinder, as this can damage the cable.
4) Clean the clear cylinder, the support rod, and the heater plate with isopropyl alcohol and a soft cloth. Use swabs dipped in alcohol around the sensors and in the holes of the heater. It is important to avoid getting alcohol on the O_2, CO_2, and Temperature/Humidity sensors, as this can cause damage. For a margin of safety, note that the red areas in the below figure should not be cleaned.



5) Reassemble the system in the reverse order. Please note the following:
   a. The clear cylinder should fit snugly over the heater gasket. It may be necessary to slightly squeeze the cylinder, forcing it round, for it to begin to slide over the gasket. Push the cylinder slowly to prevent damaging the gasket. Do not allow the cylinder to rotate to avoid damaging the cable.
   b. Both inlet and exhaust plates have a recessed circular area containing a gasket that must seal with the clear cylinder. It may be necessary to squeeze the cylinder, to make sure it seats into each recessed area correctly.
   c. Once the clear cylinder is in place, insert the knob and begin slowly tightening (clockwise). As the knob is tightened, make sure that the cylinder does not come out of place on either end. Tighten the knob until snug.