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Instrumentation for Respiratory Measurements



SmartLab device with pneumotach and CO₂ sensor

The *SmartLab™ Instrumentation System* with *Insight™* software is a flexible measurement system for use in making measurements of respiratory signals. It is a modular system that can be configured for a variety of voltage measurements. The base module consists of a main system circuit board that can accept up to four sensor modules or analog input modules. It also has inputs for a Nonin xPod oximeter, Masimo IRMA CO₂ concentration sensor both in-line and side stream models and a temperature sensor. An optional internal oxygen concentration sensor is also available. Digital I/O ports with eight outputs and four inputs can be connected to a valve controller or other device that can accept TTL level digital signals. An optional analog output module is available for retransmitting up to 4 measured or calculated values.

Sensor modules that are currently available include pressure sensors for use with Hans Rudolph, inc. pneumotachs, pressure sensors for airway pressure and absolute pressure sensors for barometric pressure or altitude measurements. A voltage input module is available for measuring analog signals from other devices. An internal temperature and humidity sensor is included and an external sensor for temperature is optional. Other modules will be released in the future. Custom designed modules can be developed if needed. Sensors are shipped calibrated and can be installed in the field as needed. Each sensor module can hold up to 5 calibration files. If a sensor is used to measure flow with a pneumotach it could be calibrated to work with several pneumotachs each with a unique calibration. The software allows the user to select the calibration table to be used for the current setup.

CAUTION: This device is for research purposes only, do not base clinical decisions on information obtained from this device.



Insight™ software example waveform display

Data is transmitted to a PC over a USB connection or a wireless RF connection. Up to 8 data signals can be transmitted at a sample rate of up to 200 Hz. The PC software will display the data on up to 8 graphs with up to 3 signals per graph. Trend graphs can also be configured to display slower data signals or calculated values over a longer period of time. An XY graph is provided for displaying graphs such as a flow volume loop. Depending on the type of signals being measured there are several calculated parameters that are measured and can be graphed as well. For flow signals, calculations for breath rate, I:E ratio, tidal volume, peak flow and estimated leak are some of the parameters that are calculated. Flow signals can be corrected for gas composition and pressure and temperature. If an airway pressure is measured then pressure parameters such as peak pressure, mean airway pressure, end exhale pressure and others are calculated. Measured and calculated values can be saved to a text file for further analysis. Incoming data can be saved in a playback file along with the setup information so that the data can be played back at a later time. Another file type is the Breath to Breath data file that saves selected parameters for each breath. There is also a feature to put custom markers on the graphs and in a file either manually or when an event occurs. The markers have a user defined text that is placed on the graph with the associated signal and also in data files. All the settings for a particular setup can be saved to a configuration file that can be recalled later to duplicate the setup.

Specifications

- Base unit holds up to 4 sensor modules
- Differential pressure sensor modules with full scale ranges from 2 cmH₂O to 350 cmH₂O
- Absolute pressure sensor module for barometric pressure or altitude compensation
- Up to 5 calibration tables for each sensor module
- + 5 or + 10 VDC analog input modules
- Two RS-232 serial ports for connection to an oximeter and CO₂ sensor
- Optional internal oxygen concentration sensor
- Internal temperature and humidity and external temperature sensor.
- Works with all the Hans Rudolph pneumotachs
- Calculates tidal volume and several respiratory parameters from the flow and airway pressure signals
- Data transmitted over USB or wireless connection
- Up to 8 data channels at up to 200 Hz rate
- 8 TTL digital outputs and 4 digital inputs
- Digital outputs can be triggered on measured values
- Measured and calculated values can be displayed and saved when a trigger event occurs
- Up to 8 graphs for real time waveform display
- Up to 3 values can be displayed on each graph
- Trend graphs for display of slower changing data
- XY graph for loop plots
- Save and recall setups for different configurations
- Record and play back data
- Stream measured and calculated data to a text file for recording and further analysis
- Manual and automatic markers placed on graphs and in files
- Write selected data to a file each breath
- Optional analog output module with 4 outputs
- Two cursors are available on each graph for measuring values at a point and the difference between two points
- Software function for calibration of pneumotachs using a calibration syringe
- Size: 4.5 inches high x 10.5 inches deep x 10 inches wide (enclosure only)
- Weight 5 to 6 lbs. (2.2 to 2.7 Kg) depending on options installed
- Services available for custom software and hardware
- Requires a computer running Windows™ 7, 8.1 or 10, i5 or better CPU and graphics card recommended



SmartLab rear panel connections

SmartLab Components & Options

Part Number	Description
263001	Series 1140 SmartLab™ Instrumentation System with Insight™ Software, select measurement modules and devices from options below
Options & Accessories	
263005	16 mm H ₂ O pressure sensor module, HRI Pneumotachs
263006	2.5 cmH ₂ O pressure sensor module
263007	5 cm H ₂ O pressure sensor module
263008	13 cm H ₂ O pressure sensor module
263009	25 cm H ₂ O pressure sensor module
263010	50 cm H ₂ O pressure sensor module
263011	70 cm H ₂ O pressure sensor module
263012	140 cmH ₂ O pressure sensor module
263013	350 cmH ₂ O pressure sensor module
263014	15 psia Barometric pressure sensor module
263018	+/- 5 VDC analog input module
263019	+/- 10 VDC analog input module
263022	In-line CO ₂ sensor with box of 25 disposable vent tube adapters (22OD/15ID x 15OD)
263023	Side-stream CO ₂ sensor with box of 25 Nomoline sampling tubes
263020	Internal oxygen concentration sensor and pump with male luer lock sampling tube, includes power supply
263016	Nonin xPod Oximeter requires a sensor. Options listed: 870871-Adult Soft Finger Sensor medium 870872-Adult Finger Clip Sensor 870873-Adult Finger Flex Sensor w/25 Wraps 870874-Adult Flex Wraps replacements (25)
263017	RF communication package includes power supply
263027	Skin Conductance input module 1.5mm DIN compatible
263028	Respiratory Band input module configured for EMBLA XactTrace Universal belt. 1.5mm DIN compatible
263021	Temperature Sensor, external, airway
263024	USB 4 channel analog output module
263100	Laptop computer configured for SmartLab™ system
Replacement Items	
871109	Wall mount power supply, 5V, supplied with oxygen sensor & RF package options.
666007	Dual tube assembly connect PNT to SmartLab, 6 ft.
666006	Single tube assembly connect airway to SmartLab, 6 ft.
263020A	O ₂ Sensor sampling line, male luer, 8 ft.
263022B	Airway Adapter in-line CO ₂ sensor, box of 25
263023B	Nomoline sampling tubes, Side-stream CO ₂ sensor, box of 25
263021C	Temperature Sensor, male luer, disposable

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