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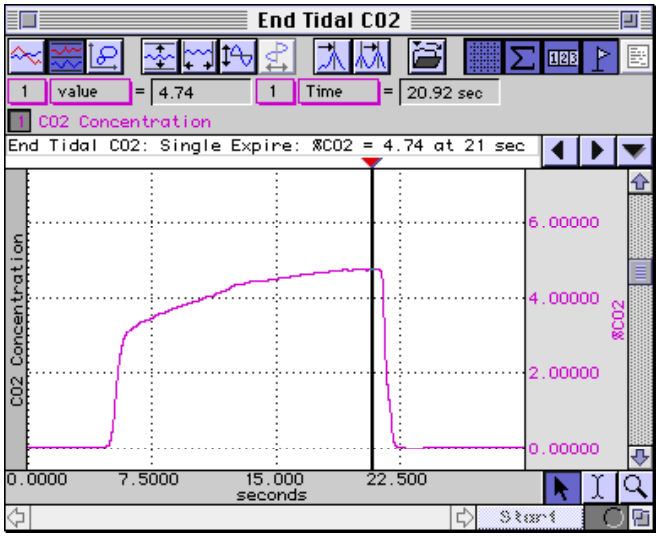
APPLICATION NOTE

07.10.18

Application Note 152 Application Example using the CO2100C Module



CO2100C for End-Tidal CO_2 Measurement

- This application note will focus on the use of the CO2100C module for measuring End-Tidal CO_2.
- See also: Application Note 151 - CO2100C Module for MP System
- Humidity effects of tubing, filters, and module setup are discussed in the O2100C-CO2100C spec sheet for Gas Concentration Measurement Modules.

The CO2100C module can be used to perform real-time carbon dioxide concentration monitoring. The CO2100C module may be used to perform analysis of expired air during the course of a pulmonary function or exercise physiology test.

A factor affecting carbon dioxide production measurement is the response time of the CO2100C module. Nominally, the step response time of the CO2100C module is 250 msec for 100 ml/min flow rate. For breath rates exceeding 84 BPM (using the formula: Tr = 0.35 / Fh), the CO2100C will begin to attenuate its response to carbon dioxide changes.

When measuring CO_2 concentration changes during the course of a breathing cycle without the use of a mixing chamber, the response time of the CO2100C module is critical. Generally considered, then response time of the module is adequate for most breath-to-breath measurement applications. However, if the response needs to be faster. It can be improved by increasing the sampling flow rate of the CO2100C module.

When using a mixing chamber to average CO_2 concentration over many breaths, there is no performance degradation when measuring CO_2 concentration ranges for arbitrarily high breathing rates. Accordingly, a mixing chamber is typically recommended for quick, accurate and easy metabolic analysis. In the case of End-Tidal CO_2 measurements, however, a mixing chamber can't be used because it will average the peak CO_2 response.

The End-Tidal CO_2 measurement is simply the peak concentration of CO_2 at the tail-end of an expire. To perform this measurement, the CO2100C module should be connected directly to the sampling port of the AFT non-rebreathing "T" valve.

The CO2100C module is normally used in conjunction with an MP system. The CO2100C connects to the monitored gas flow via the AFT20 Gas Sampling Interface Kit. The AFT20 kit is used to connect the CO2100C module to a mixing chamber (e.g. AFT15A) which is on the output end of a non-rebreathing "T" valve (e.g. AFT21) or, in this case, directly to the AFT21 itself. The input end of the "T" valve connects to a Pneumotach (airflow) transducer, like the TSD107B.

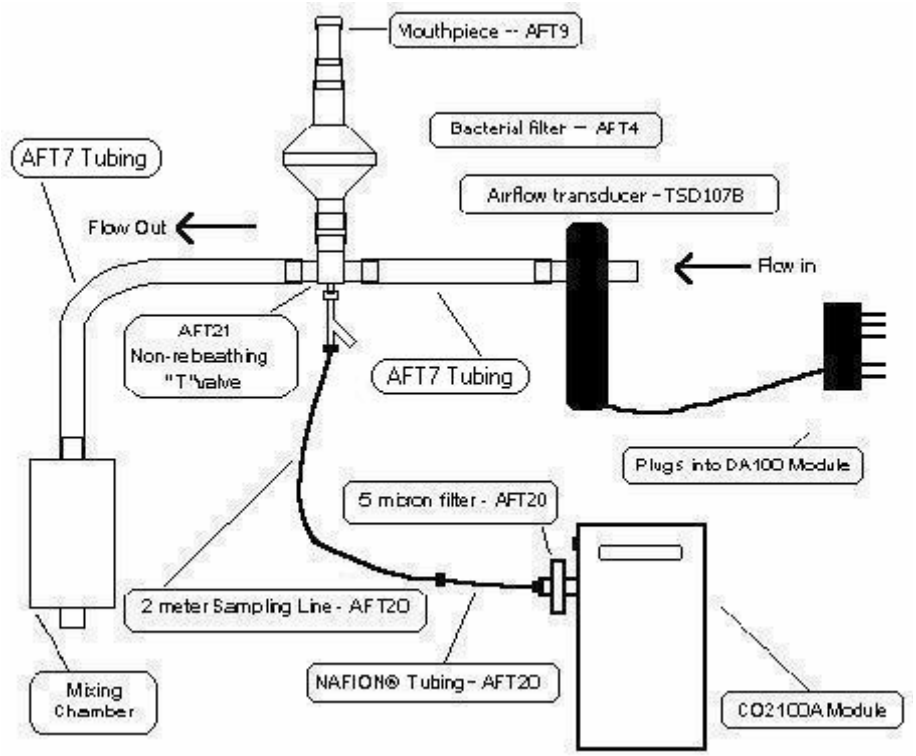
Assuming the CO2100C module is connected to the sampling port of the AFT21, via the AFT20m gas sampling interface kit, the module will sense changes in carbon dioxide concentration as the subject breathes.

For determining the amount of carbon dioxide produced by the subject over a long time period, connect the CO2100C module directly to the mixing chamber. Because the TSD 107B is placed in the "Flow In" line, the total volume of inspired or expired air can be determined by integrating the airflow output signal (assuming RER = 1). Finally, because both the carbon dioxide concentration and total volume of expired air are known, it is possible to estimate the approximate amount of carbon dioxide produced by the subject during the course of breathing.

Like all CO2100C gas sampling equipment, the CO2100C module measures the partial pressure of carbon dioxide in its internal sample cell, and is therefore sensitive to changes in ambient pressure. When connecting the module sampling line to the mixing chamber, ambient pressure influences on the carbon dioxide reading are minimal.

The following diagram illustrates a typical connection for the CO2100C module to the AFT21 for purposes of End-Tidal CO_2 measurement. The subject breathes through the mouthpiece (AFT9) which attaches to the non-rebreathing "T" valve (AFT21) via a bacteria filter (AFT4). When the subject inspires, air is drawn into the AFT21, through the TSD107B airflow transducer, as shown by the "Flow In" arrow. When the subject expires, air is forced out through the mixing chamber. CO2 levels can be sampled at the gas sampling ports of the AFT21 or the mixing chamber.

If only End-Tidal measurements are required, the flow transducer (TSD107B) and mixing chamber (AFT15A) are not required. However, when performing metabolic analysis or long-term CO2 production measurements, these elements will be necessary.



CO2100C Connection for End-Tidal CO_2 Measurement

Waveform – End Tidal CO_2

The "End-Tidal CO_2" graph on Page 1 illustrates data collected using the previously defined setup procedure. The waveform shown is calculated and derived by Acq*Knowledge* in real time. This waveform is simply the output of the CO2100C module recorded during a subject's single expiration. Note that the CO_2 concentration peaks out just prior to the subject's inspiration.