FCM41 Fast Gas Concentration Meter

Figure 1 Fast gas concentration meter FCM41

The FCM41 fast gas concentration meter is used to determine the concentration of a specific gas, CO_2 or N_2O. The concentration value is expressed in ppm and determines the ratio of the number of molecules of a specific gas to the number of molecules of a mixture of gases. Assuming that during the measurements there are conditions for which it is possible to apply the ideal gas laws, the concentration value determines the volume fraction of the gas in the mixture. The meter uses the method of non-dispersive absorption of infrared radiation to determine the concentration. A resistance element heated to 650°C was used as the radiation source, and a planar multi-channel pyroelectric detector was used as the detector. Gas samples are introduced into the measuring chamber of the meter continuously through sampling tubes with an internal diameter of about 2mm. Gas flow through the measuring chamber is forced by an additional SMP50 sampling module or by any external suction pump. The small volume of the measuring chamber, the small diameter and length of the sampling tubes, together with the appropriate flow rate of gas samples through the chamber, ensure good dynamic properties of the meter. Gas concentration measurements are performed with a frequency of 4Hz. For a gas sample flow rate of 5 SmL/s (standard flow rate - at temperature 0°C and 1013 hPa absolute pressure) through 2-meter-long, 2-mm-diameter sampling tubes, the meter's frequency response is 0.5 Hz. Using additional software in the "post-process" mode, based on the recorded measurement results, the bandwidth of the measurement system can be extended to 1 Hz. The correction of the concentration value is calculated based on the parameters entered, such as the length and diameter of the sampling tubes, and the sample gas suction flow rate.

Application.

The meter is used to measure the effectiveness of ventilation systems, during which a tracer gas is introduced into the air to simulate real-life pollutants. Good dynamic properties of the meter allow to measure tracer gas concentrations anywhere in the room, especially in the human breathing zone, where there is a complex and dynamic interaction of air streams: human convective stream, exhaled air stream from the lungs and various air streams from the ventilation and air conditioning system. The use of a fast gas concentration meter allows for the measurement of fast changes in the concentration value, thanks to which a reliable analysis of human exposure to pollutants in the air inhaled into the lungs is possible.

Figure 2 Front panel of FCM41

Software.

The meter sends the measured concentration values via the ZigBee wireless transmission link to the transmission module FCM414 connected to the computer via the universal USB serial bus. Concentration values are displayed on the computer screen in the form of time courses. At the same time, the data received from the meter can be saved to a file on a computer disk. After the measurements are completed, the saved data can be loaded into the program that enables the dynamic correction of the signal in order to extend the measurement bandwidth of the system to 1 Hz.

The transmission module connected to the computer is able to read the measurement results from several meters at the same time. When recording is turned on, the software saves the measurement results to separate files whose name includes the serial number of each meter. In this way, it is possible to create a simple multi-channel measurement system consisting of one transmission module and several meters. In order to synchronize data from different meters, the data sent from the concentration meter contains two markers: real time (hh:min:sec dd.mm.yyyy) and an individual marker for each measurement (integer modulo 256). Thanks to time stamps, it is possible to synchronize measurement results from different meters with an accuracy of 0.25 seconds. Measurement markers, in a system consisting of many meters, are synchronized using one common synchronization signal transmitted to the meters via TOSLINK fiber optic lines. The use of fiber optic lines prevents mutual interference of the meters.

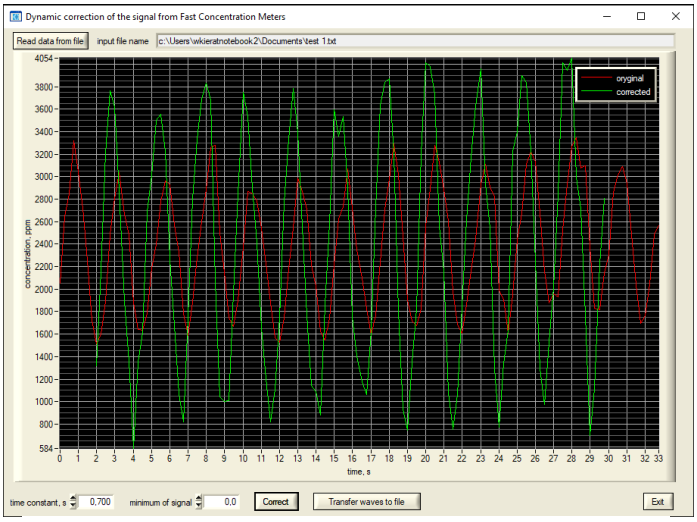

Figure 3 Screen of software used for dynamic correction of recorded measurements.

Technical parameters

Gases to be determined - N_2O, CO_2
Measuring principle – NDIR
Concentration range – 0 to 5000ppm (optional 50000ppm)
Expanded uncertainty +- 20ppm or 5% of reading (which is higher)
Long-term stability, 1 year - +- 50ppm
Measuring rate – 4Hz
Time constant of response – 0,7s (0,3s with postprocess correction)
Temperature compensation – yes
Barometric pressure compensation – yes
Communication method – wireless ZigBee, USB
Power supply – 220-230 AC / 50 Hz
Gas sampling method – via tube with external sampling unit or suction pump