High-Speed Sensors Improve CO_2 Response Time for Incubators

Gas Sensing Solutions Ltd.

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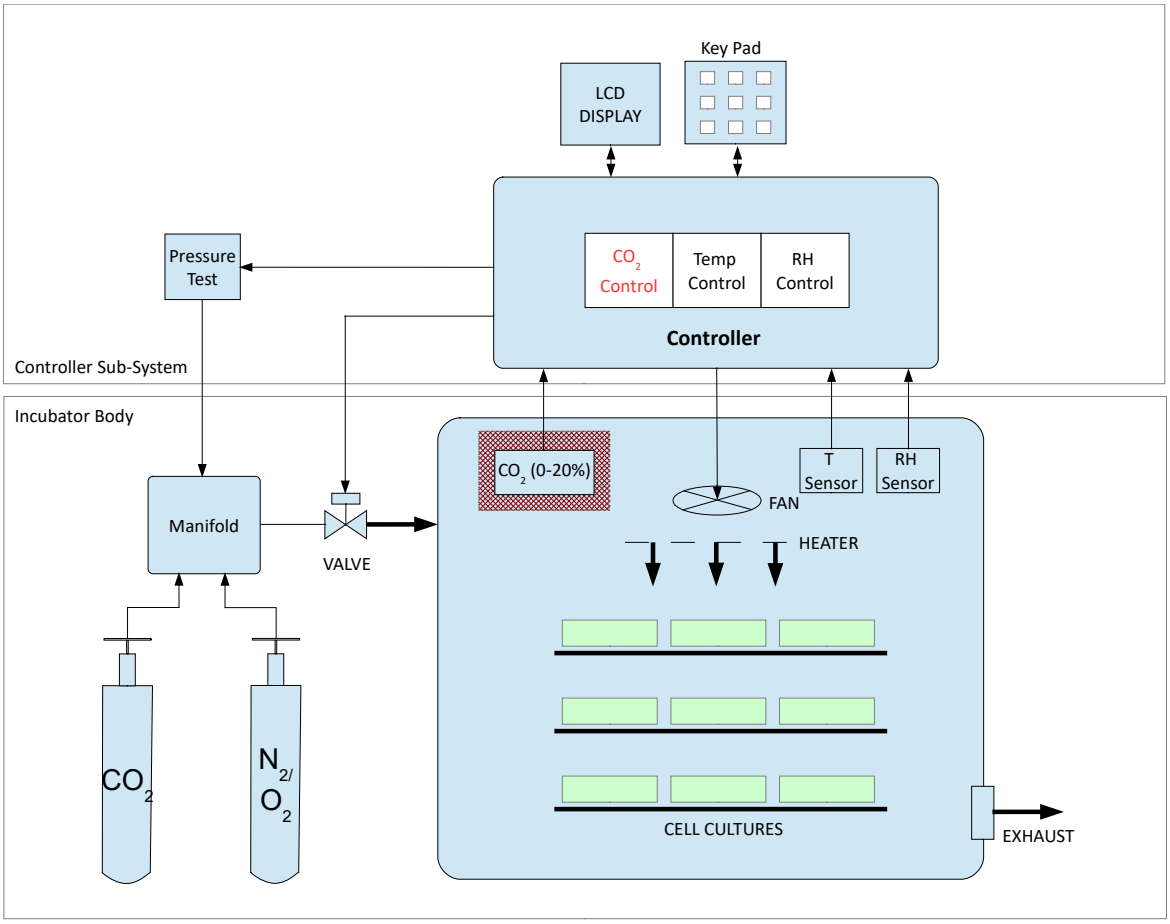
INTRODUCTION

CO_2 incubators are designed to mimic a cell's natural environment and ensure conditions are constant. Although there are different types of incubator, most are designed to control CO_2, relative humidity, temperature and pH at constant levels. New high-speed CO_2 sensors are now available that allow designers to respond and manage gas levels with unprecedented fidelity.

WHAT IS AN INCUBATOR?

Micro-organism incubators are essentially ovens that are temperature-controlled, to work within a strict biological range and are mainly used for cultivating and storing microbial culture. These incubators can be found in laboratories across the world and are an essential piece of equipment. Both medical and biological labs use incubators to provide the correct controlled environment for successfully growing cultures.



WHY CO_2 NEEDS TO BE MEASURED?

Cultures grown within incubators require very specific environmental conditions. Typically, incubators allow the user to monitor and adjust different factors such as temperature, relative humidity and carbon dioxide levels to control pH of growth medium to ensure optimal growing or storage conditions are maintained.

Cell growth is managed by controlling the pH value, which is typically in the range from 7.0 to 7.7. Chemical reactions within the medium can alter the pH. In order to counter these reactions, levels of CO_2 are controlled, helping to maintain a steady pH equilibrium in the growth medium.

If there is not enough CO_2 in the atmosphere, CO_2 will outgas from the culture media, and the substance will become too alkaline; excessive CO_2 concentration in the atmosphere will cause more CO_2 gas to be absorbed by the mixture, leading to high acidity levels. Providing a controlled CO_2 atmosphere helps maintain the required concentration of CO_2 in the growth medium, stabilising the resultant pH.

WHAT ARE THE REQUIREMENTS FOR THE CO_2 SENSOR?

A CO_2 sensor used in a cell incubator should be responsive, accurate and stable over time. Undesired changes within the incubator are likely to have a negative impact on the culture, and it is therefore vital to know when CO_2 levels have changed, as well as the extent of the variation and to be able to respond accordingly. Due to the high humidity environment, action also needs to be taken to mitigate the effects of high humidity levels particularly during the sterilisation process. Condensation on the sensor will cause the sensor to report inaccurate results.

Having a fast CO_2 sensor that can detect a change in CO_2 gas levels enables adjustments to be made in near real-time, reducing the opportunity for the incubator environment to drift far from nominal.

NDIR CO_2 SENSORS

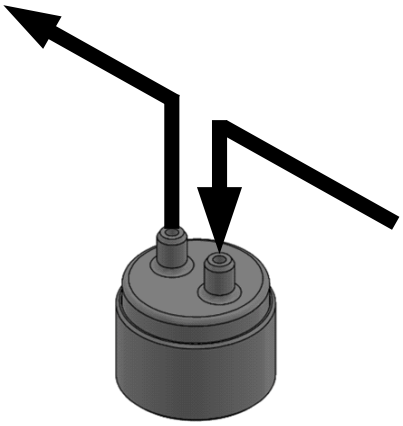
Gas Sensing Solutions' CO_2 sensors use a solid state, LED light source. This type of light source has numerous advantages, particularly for applications that need high response times. The CO_2 gas is strongly absorbed by mid-IR 4.25um light. GSS manufactures its own LEDs, which have been specifically designed to emit a narrowband of light centred at 4.25um.

GSS has designed a family of high speed, high response rate CO_2 sensors specifically targeted at applications that require near real-time CO_2 measurement capability.

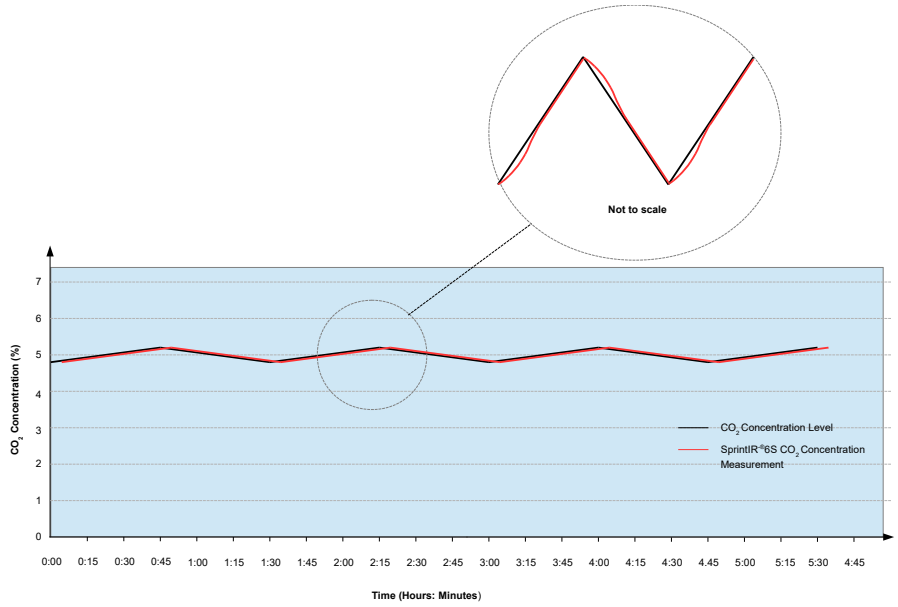
INTRODUCING THE SPRINTIR-6S AND EXPLORIR-W

The SprintIR-6S and ExplorIR-W series of sensors are a range of high accuracy carbon dioxide (CO_2) sensors designed to meet the needs of customers who require fast measurement of CO_2 levels. The sensors are designed to take a reading 20 times a second for the SprintIR-6S and 2 times a second for the ExplorIR-W. The optical cavity has been designed along with a flow port adaptor to enable gas to flow through the sensor at high speed, enabling the user to make use of the very high measurement rate capability.

The flow port adaptor has been designed to allow CO_2 gas to be exchanged inside the gas measurement chamber.



Both series of sensors are available with CO_2 concentration ranges from 0-5%, up to 0-100%. They feature a typical measurement accuracy of 70ppm and have built in auto-zeroing, ensuring excellent long-term accuracy.



In most applications, with a measurement rate of up to 20Hz, the ability of the sensor to provide real-time readings will be limited by the flow rate through the sensor. The most important factor is the gas exchange rate. This is the amount of time it takes for the gas to enter the CO_2 measurement chamber, get measured and then replaced. The sensor has a gas measurement chamber volume of approximately 2.8ml. As a rule, to properly exchange the gas in the chamber, there needs to be a x5 volume of gas passed through the sensor. Therefore, approximately 14ml of gas needs to flow through the sensor for each reading to be effective.

$$\boldsymbol{Max\ Flow\ Rate}\ (\boldsymbol{l/min}) = \frac{\boldsymbol{20\ reading/s * 60s * 14ml}}{\boldsymbol{1000}}$$

The maximum flow rate supported by the SprintIR-6S is approximately 19ltr/minute CO_2 before the sensor is unable to track the gas flow.

CONCLUSION

The SprintIR-6S and ExplorIR-W CO_2 sensors from GSS have been specifically designed to address applications where high measurement rate, responsiveness and long-term accuracy are paramount. Suitable for CO_2 incubators and a variety of other life science applications, they come with several options that allow the sensor to be optimised for the installation.

To learn more about how the SprintIR-6S or ExplorIR-W, visit our website https://www.gassensing.co.uk/products/

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