APPLICATION NOTE 0025

Choosing an eosGP Output Option

INTRODUCTION

To provide flexibility and wide-ranging data logger compatibility, the eosGP offers three output options; Analog, Streaming RS485 digital, and Modbus RS485 digital. This application note is intended to help users choose the right output option for their needs. It provides a brief description of each type of output and highlights their respective pros and cons.

Feature	Analog	Streaming RS485 Digital	Modbus RS485 Digital
Compatible with widest range of data loggers	✔		
No resolution loss from signal conversion		✔	✔
No need to artificially constrain output range		✔	✔
Capable of reporting multiple variables (CO_2 and temperature)		✔	✔
No signal degradation over longer cable lengths		✔	✔
No data clipping, except at the maximum range of the sensor		✔	✔
Multiple sensors per datalogger channel			✔

Analog

An Analog signal is a voltage representation of a time-varying variable, like CO_2 in the case of the eosGP. Despite being among the most universally compatible communication modes, there are several implications to using an Analog signal.

First, the granularity of a voltage signal is limited by the bit count of the digital to Analog conversion (DAC). For example, the CO_2 sensor housed inside the eosGP has 0-10 V capabilities with 12 bit resolution. This means there are 4,096 possible output values. The default voltage output for the eosGP is 0-5 V and the default calibration range is 0-30,000 ppm CO_2. The digital concentration values output by the sensor are linearly scaled to voltage readings from 0 to 5 V. As a result, there are 2,048 possible output values (i.e. half of the full 10 V resolution), or CO_2 concentration readings in increments of 15 ppm.

The granularity can be improved in the above example if the concentration range of the eosGP is reduced. Suppose that values above 10,000 ppm were not anticipated, the eosGP could be configured such that the 0-5 V range would span 0-10,000 ppm, which would decrease the interval reported concentration values to increments of 5 ppm. However, due to data clipping, the sensor would no longer be capable of reporting values >10,000 ppm.

Data clipping is another implication of Analog communication, as it results in a loss of range. Values that exceed the range applied to the DAC will simply be reported as the maximum value in the range (i.e. 30,000 ppm for the full sensor range).

There is also loss of voltage signal with increasing lengths of cable because resistance over the cable is also increased. This is compounded by the fact that resistance is non-constant and can vary with conditions (e.g. atmospheric temperature, moisture, etc).

When using an Analog signal, another important thing to note is that each channel can only communicate a single variable. Therefore, because the CO_2 sensor inside the eosGP has a single Analog channel, the sensor's internal temperature readings can not be recorded by the data logger.

Streaming RS485 DIGITAL

With Streaming RS485 the signal is fully digital, and the output does not suffer from the same loss of granularity associated with DAC or loss of signal with cable length seen in Analog output.

A significant advantage of Streaming RS485 is that this communication mode is capable of reporting multiple variables. This means that the sensor's internal temperature, pressure set point, O_2 set point, and RH set points can be recorded by the data logger. There is also no data clipping unless the concentration exceeds the maximum range of the CO_2 sensor housed within the eosGP.

When using RS485 Streaming, it is also possible to send information from the data logger to the sensor. For example, O_2, pressure and RH set point values can be sent to the sensor from the data logger to increase the accuracy of the CO_2 measurements on the fly. However, it is important to note that sensor readings can not be recorded while sending information to the sensor.

There are a few drawbacks to Streaming RS485. In particular, it is limited to one sensor per channel and it requires a data logger with an RS485 converter, which limits data logger compatibility. Furthermore, data is sent to the data logger as a continuous string of text that must be parsed by the user in order to be read and analyzed. This can be done fairly easily by uploading a program to the data logger.

MODBUS RS485 DIGITAL

Modbus RS485 is also a digital communication mode. It has all the same advantages as Streaming RS485 when compared to Analog. However, there are a few distinct advantages in choosing Modbus over Streaming.

An advantage of Modbus RS485 is that the data transfer protocol is an industry standard that is supported by compatible data loggers out-of-the-box, so minimal code is required. However, perhaps the biggest advantage of Modbus RS485 is that it allows users to connect multiple sensors to a single channel, meaning multiple sensors can share a single loggerl. In addition to also requiring the data logger to have an RS485 converter, use of Modbus RS485 also requires that the data logger have Modbus capabilities, potentially limiting it's compatibility.

RECOMMENDED DATA LOGGERS

Analog	Streaming	Modbus
Campbell Scientific		
CR6 CR300* CR800 CR1000 CR1000X	CR6 CR1000** CR1000X	CR6 CR1000** CR1000X
Monarch Instruments		
Track-It		
NexSens		
		X2-SDL

* Voltages must be scaled from 0 - 2.5 V

** Requires a MD485 interface module

CONCLUSIONS

Analog communication offers the most flexibility but has several drawbacks, digital modes like Streaming RS485 and Modbus RS485 provide the best accuracy and Modbus RS485 allows for multiple sensors per logger.There are pros and cons to each communication mode and the best choice largely depends on the deployment site and data logger compatibility.