

Interfacing the eosGP with a Campbell Scientific Datalogger

INTRODUCTION

Campbell Scientific dataloggers offer a plethora of options for connecting and recording multiple sensors. The Eosense eosGP CO₂ gas probe has multiple output options each with their own benefits and drawbacks. Using the CR1000X as a working example, this application note will demonstrate the connection process for each of these modes and help you decide which method is right for your application.

Please note that in order to use the eosGP's Modbus or Streaming output options, your data logger will need to include terminals with RS485 communication functionality. For example, on the CR1000X this functionality is only available on ports (C5 & C6) and (C7 & C8). You can read more about eosGP communication modes in this [Application Note](#).

REQUIRED COMPONENTS

- eosGP
- Campbell Scientific CR1000X data logger
- Short Cut or Loggernet software
- Standard power/data cable with bare leads (hereafter referred to as the bare leads cable)

STREAMING MODE

The default mode for the eosGP is Streaming, which outputs a line of serial data over RS485 approximately every second. Streaming mode is useful when dedicating RS485 data logger ports to each sensor for long-term deployment.

To connect sensors in Streaming mode, simply connect the pink wire from your bare leads cable to terminal C5 (or C7), and the white wire to the next terminal (C6 in this example, or C8 if you're using C7) as shown in **Figure 1**. The eosGP can be powered by the logger's 12 V supply by connecting the red wire to the 12V terminal and using the brown wire as ground.

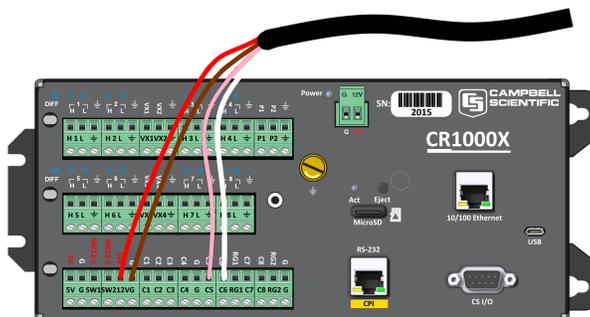


Figure 1. CR1000x wiring in Streaming mode.

A demonstration program is shown below (**Text 1**). The blue text represents a basic CR1000X program which measures and records battery voltage and internal datalogger temperature. The red text represents the lines of program code which are added to extract and record the CO₂ concentration, and temperature from the eosGP.

The lines starting with “SerialOpen” and “SerialIn” contain references to “ComC5”. These can be changed based on the serial ports that are being used (e.g. ComC7 can also be used on the CR1000X). The eosGP outputs a new serial reading approximately every 1 s by default (“Scan” should have a frequency of greater than 1 second). When each new serial message arrives, the concentration and temperature are updated. Calling the data table will store these most recent values. If the “DataTable” frequency is faster than the scan rate, the same readings will be stored multiple times since the data is only updated each time a scan is completed.

This data table is currently set to take a sample of the most recent concentration and temperature readings. If you would like to take an average of readings instead, simply change the lines beginning with “Sample” to “Average”.

The default output of Streaming mode contains the most recent CO₂ concentration measurement, corrected for sensor temperature as well as pressure, relative humidity and O₂ set-points (**Figure 2**). In the demonstration program below, each of these values are temporarily stored in the SerialFields() array (**Text 1**).

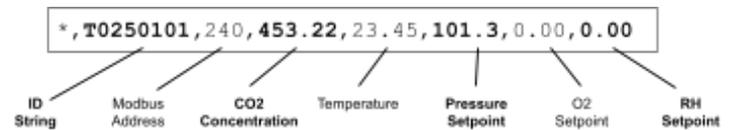


Figure 2. Default output of eosGP in Streaming mode.

Please note that storing these values in the SerialFields() array does not mean that they are stored in the data table. In the demonstration program (**Text 1**), only the CO₂ concentration and temperature data from the above string are stored in the data table. You can access other values from this string by creating a new variable and setting it equal to SerialFields (index of your variable in **Figure 2**). For example, GP_Temp = SerialFields(4) . Then, save your variable in the data table as a float (i.e Sample(1, GP_Temp, Float)).

```

'CRBasic eosGP Control Demo 'Created by Eosense (C)
2020 'Version 1.0.0

'Declare Variables
'=====
Public BattV
Public SerialInput As String * 100
Public SerialFields(7) As String * 16
Public NBytesReturned
Public PTemp_C
Public GP_CO2Conc As Float
Public GP_Temp As Float
Units BattV=Volts
Units
PTemp_C=Deg
C

'Define Data Tables
'=====
DataTable(Table1,True,-1)
    DataInterval(0,16,Sec,10)
    Sample(1,BattV,FP2)
    Sample(1,PTemp_C,FP2)
    Sample(1,GP_CO2Conc,Float)
    Sample(1,GP_Temp,Float)
EndTable

'Main Program
'=====
BeginProg
    'Initialize serial port
    SerialOpen(ComC5,19200,0,50,500,4)
    'Main Scan
    Scan(2,Sec,0,0)
        Battery(BattV)
        PanelTemp(PTemp_C,_60Hz)
        'Read GP serial data
        SerialInRecord(ComC5,SerialInput,
        &h53,70,0,NBytesReturned,01)
        'Seperate input into fields
        SplitStr(SerialFields(),SerialInput,
        ",",7,0)
        'Store CO2 Concentration as floating
        point number
        GP_CO2Conc = SerialFields(3)
        'Store temperature as floating point
        number
        GP_Temp = SerialFields(4)
        CallTable Table1
    NextScan
EndProg

```

Text 1. Source code listing (GP_Streaming_Demo.CR1).

MODBUS MODE

When using multiple [eosGP](#) sensors together, Modbus mode offers a convenient way to collect serial data without requiring multiple data lines. In Modbus mode, each eosGP in the group has a unique address and they share a single RS485 communication line. In this mode the sensors will not send data unless they receive an addressed request. When using multiple sensors, it is critical that a unique address be used for each.

To connect sensors in Modbus mode, simply connect the pink wire from your bare leads cable to terminal C5 (or C7), and the white wire connected to the next terminal (C6 in this example) as shown in Figure 3. The eosGP can be powered from the logger's 12V supply by connecting the red wire to the 12V terminal and using the brown wire as a ground reference.

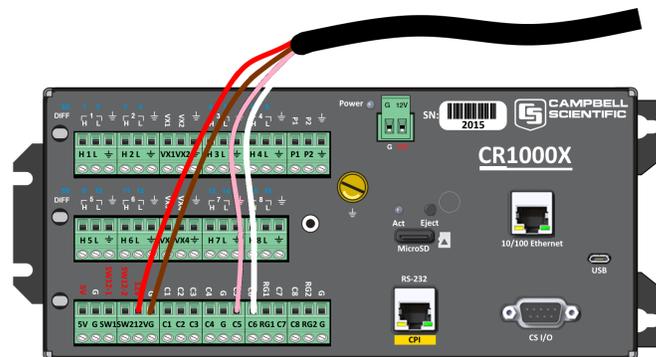


Figure 3. CRX1000 wiring in Modbus mode.

A demonstration program is shown in the listing below. The red text represents the lines of program code which are added to extract and record the CO₂ concentration, and temperature from the eosGP in Modbus mode.

The lines starting with “ModbusMaster” contain a reference to the eosGP’s Modbus address, which is 240 in this demonstration (**Text 2**). You will need to change these values to your own sensor addresses. If your sensors were configured in Modbus mode when you ordered them, then the Modbus address is printed on the outside of each sensor.

Please note that in this demonstration only one sensor was used. If you need help extending this code for use with multiple sensors please contact Support@eosense.com

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```
'CRBasic eosGP Control Demo 'Created by Eosense
(C) 2020 'Version 1.0.0

'Declare Variables AND Units
'=====
Public BattV
Public PTemp_C
Public GP_CO2Conc
Public GP_temp
Public Result
Units BattV=Volts
Units PTemp_C=Deg C

'Define Data Tables
'=====
DataTable(Table1,True,-1)
  DataInterval(0,16,Sec,10)
  Sample(1,BattV,FP2)
  Sample(1,PTemp_C,FP2)
  Sample(1,GP_CO2Conc,Float)
  Sample(1,GP_temp,Float)
EndTable

'Main Program
'=====
BeginProg
  SerialOpen(ComC5,115200,20,50,200,4)
  'Main scan
  Scan(4,Sec,0,0)
  Battery(BattV)
  PanelTemp(PTemp_C,_60Hz)
  'Read CO2 and temperature data from
  sensor with Modbus addr 240
  ModbusMaster
  (Result,ComC5,19200,240,3,GP_CO2Conc,1,1,
  3,100)
  ModbusMaster
  (Result,ComC5,19200,240,3,GP_temp,5,1,3,1
  00)
  CallTable Table1
  NextScan
EndProg
```

Text 2. Source code listing (GP_Modbus_Demo.CR1)

ANALOG MODE

If Modbus and Streaming mode are unavailable (perhaps due to a lack of inputs or RS485 capabilities) the eosGP can be connected in Analog mode in two different ways (differential voltage mode or single-ended voltage mode).

Differential Voltage Mode

When connecting your eosGP sensors in Analog mode, it is best to use differential voltage mode if possible as it reduces noise in the data. To connect the eosGP to the CR1000X in differential voltage mode simply connect the grey wire from the bare leads cable to the ground terminal to switch to Analog mode, use the pink wire to

supply your analog output and blue wire to supply a separate ground reference for your analog reading. The analog/ground pairs can then be connected to high/low (H/L) differential input pairs on the CR1000X as shown in Figure 4.

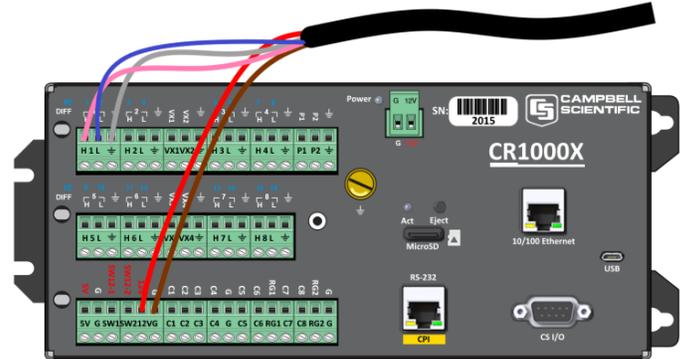


Figure 4. CR1000X wiring in differential voltage mode.

This setup can be configured using Campbell’s Short Cut program. Under the sensor tab, select “Differential Voltage Mode” (Figure 5) and add CO₂ concentration as your measurement result in the properties box (Figure 6). Use Table 1 to set the appropriate multiplier and offset values for the output range of your sensor.

Range (ppm)	Range (V)	Multiplier	Offset
400-1000	0-5	0.12	+400
0-10,000	0-2.5	4	0
	1-5	2.5	-2,500
0-30,000	0-5	2	0
	0-2.5	12	0
0-200,000	0-5	6	0
	0-2.5	80	0
	0-5	40	0

Table 1. Multiplier and offset values for different expected CO₂ ranges.

By default, variables are stored as “FP2” or floating point 2. In order to conserve memory, data stored in FP2 format must be less than 8000. Therefore, if you expect to see values greater than 8000 you can change the format by selecting *Advanced Outputs > Options >Resolution >High*.

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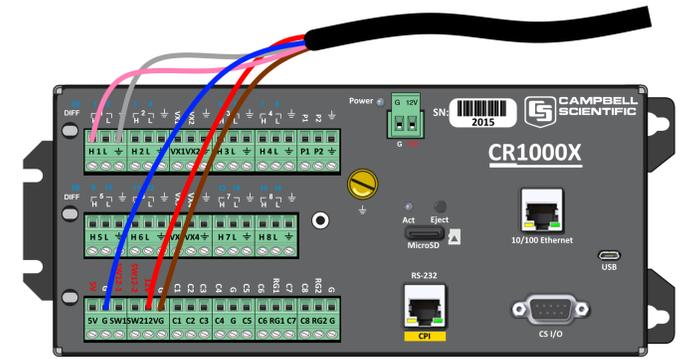
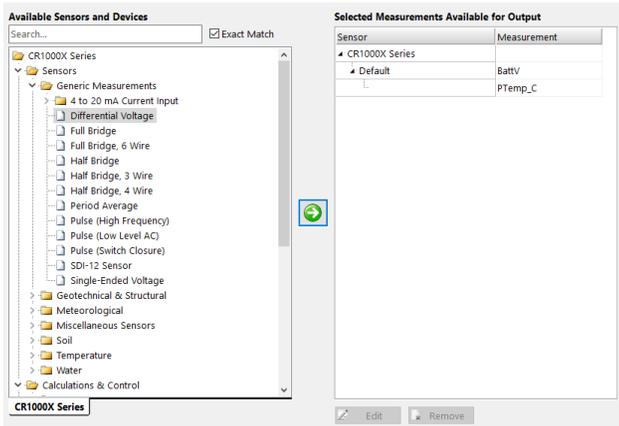


Figure 5. CR1000X wiring in single-ended voltage mode.

Figure 5. Adding variables in differential voltage mode Short Cut

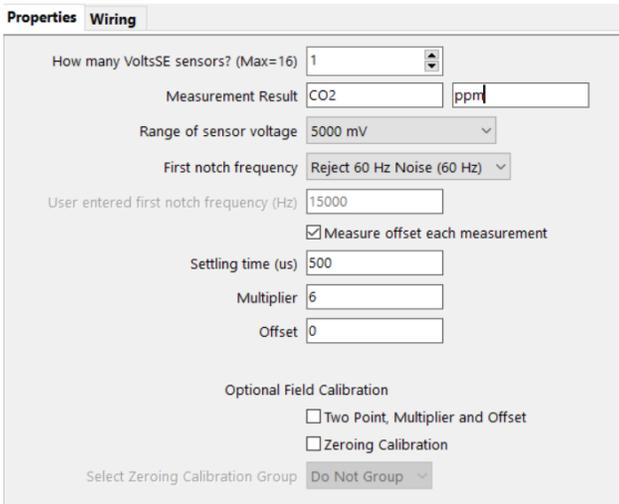


Figure 6. Short Cut properties box.

Single-Ended Mode

If differential mode is unavailable the eosGP can be connected in single-ended mode, however this is the least accurate mode and should only be used when there are no other options. Because the eosGP draws large but short-duration current pulses to power its sensor, a varying amount of voltage is dropped across the ground lead of the cable (an effect that gets worse with longer cables).

The configuration in Short Cut uses “Single-Ended Voltage” as the sensor type, but all other settings are the same as for differential mode (Table 1). To connect the eosGP to the CR1000X in single-ended mode, use the grey wire from the bare leads cable as a ground reference, and connect the pink wire to high (H) as shown in Figure 5. We recommend connecting your blue wire to ground if possible, as it can help to reduce the current-spike noise.

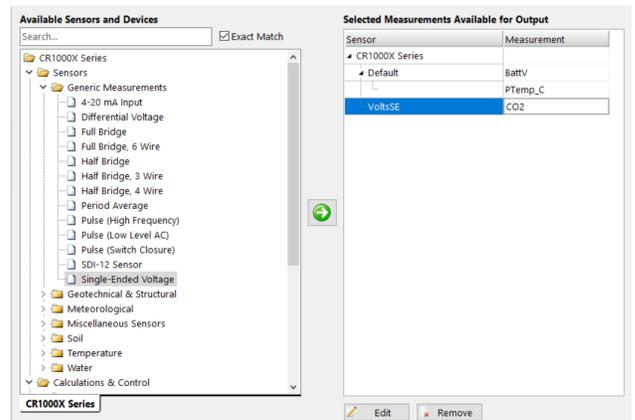


Figure 5. Adding variables in single ended voltage mode Short Cut.

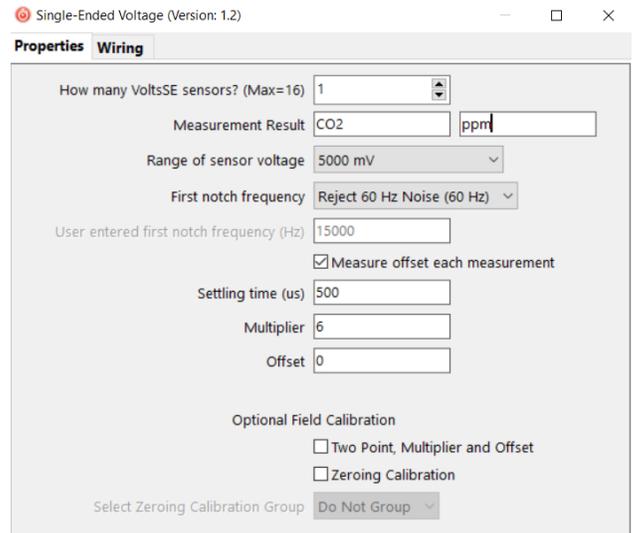


Figure 6. Short Cut properties box.

CONCLUSION

Whether you choose Streaming, Modbus or Analog mode to set up your eosGP, we hope that this guide helps you to connect to your Campbell Scientific datalogger. Any further questions can be directed to our support team at support@eosense.com.