COZIR™ Analog Voltage Output Option

1 Introduction

The standard COZIR™ range of CO_2 sensors (no RH/T or SprintIR 20Hz) have a voltage output that is proportional to the averaged CO_2 concentration.

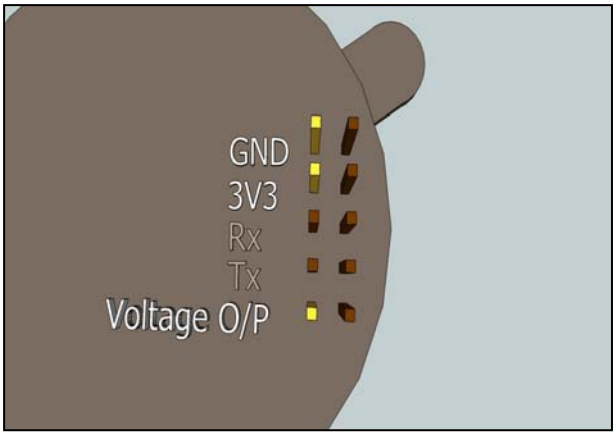
Key points to note are:

- Analog voltage output is proportional to the range of the supply voltage and the CO2 concentration.
- The maximum voltage output (full scale) will always be that applied to pin 3 of the 10 way connector.
- Care must be exercised in selecting the load resistance connected between the voltage output (pin 9) and GND (pin 1)
- The voltage output pin (pin 9) is an output pin only. Take care not to feed any voltage/current into the voltage output pin.
- The supply voltage should be 3.3V+/- 0.1V. The sensor can operate at higher voltages, however the offset voltage becomes problematic outside the standard operating voltage range.

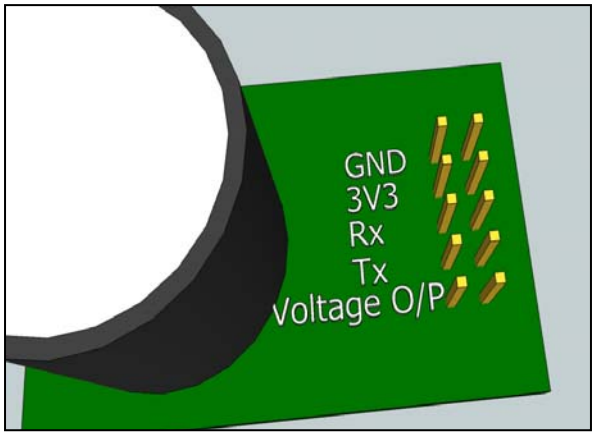
2 Voltage Output

2.1 Connections

The voltage output is available on pin 9 of the sensor. Power and ground must be applied to pins 1 and 3.



COZIR-A Series Connections



COZIR-W Series Connections

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2.2 Load Impedance

The COZIR™ voltage output pin has an internal resistance of approximately 150Ω. The internal capacitance between the voltage output pin and 0V is 220nF. This gives the output a single order high frequency roll off at about 4.8kHz.

To avoid loading issues affecting the measurement, it is essential to ensure that load connected to the voltage output pin (9) is greater than 10kΩ and preferably greater than 100kΩ.

Load Resistance	Loading Error
4k7	3%
10k	1.5%
100k	0.1%
500k	0.03%

3 Output Voltage

The voltage output is provided by Pulse Width Modulation (PWM) of the sensor supply voltage. This means that all voltage outputs are relative to the supply voltage. For example, if the supply voltage is 3.4V, then the full scale output from the voltage pin will also be 3.4V, the half scale voltage will be 1.7V etc.

To convert a voltage into a CO_2 concentration:

$$Concentration = FS * V_{out}/V_{supply}$$

Where

FS = Full Scale Concentration
V_{out} *= voltage output (at pin 9)*
V_{supply} *= supply voltage (at pin 3)*

All voltages relative to GND (pin 1)

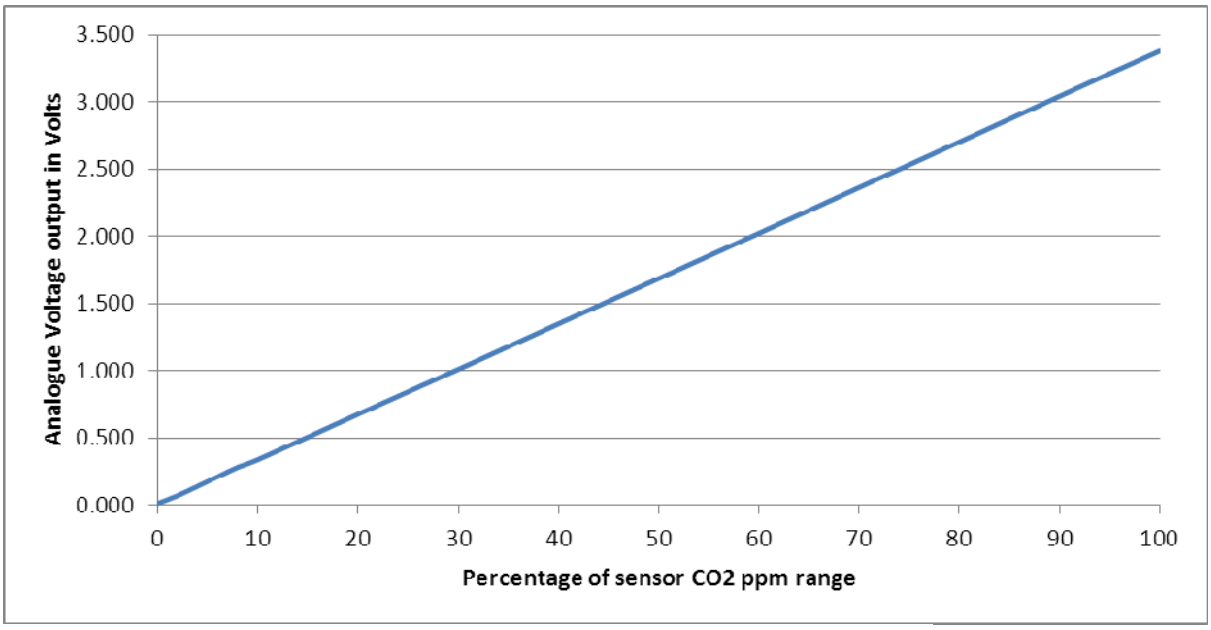
Note that there is a slight zero offset (see below) which should be taken into account for readings below 10% of the Full Scale.

3.1 Linearity of the Voltage Output

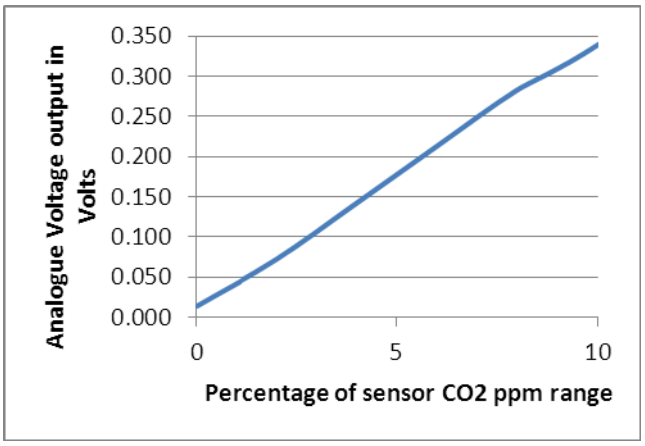
Figure 2 shows a typical plot of output voltage (at pin 9) vs CO_2 concentration.

- Note that the output voltage is linearly dependent on the CO_2 concentration measured by the sensor.

- Note also that for CO_2 concentrations less than 10% of full scale, the sensor output voltage is affected by the output Operation Amplifier offset voltage (~14mV). See below.



Output Linearity. (This graph assumes a supply voltage of 3.3V)



Effect of zero offset close to 0. (This graph assumes a supply voltage of 3.3V)

3.2 Noise on the Voltage Output

The typical noise present on the voltage output is as follows with the voltage output at half full scale:

- 140µVrms measured in a 20 kHz bandwidth.
- 450µVrms measured in a 10 MHz bandwidth.

- In a 10MHz bandwidth the highest noise voltage amplitude is at least 70dB below the desired DC output voltage.

4 Digital outputs

The digital (serial) Rx and Tx connections are still available and active when the voltage output is fitted. This allows the sensor to be calibrated and configured over the serial connections.

5 Zero Point Calibration

The serial communication options are also available (see the *COZIR Software User's Guide*).

The COZIR sensor requires periodic zero point calibration. In many cases, this can be done automatically using the built in auto-calibration option.

Additionally, two zero calibration pins area available.

Nitrogen Zero (Pin 8)
This pin is normally high. Hold it low for 1.5s to trigger a nitrogen zero. This assumes that the sensor is free from any CO2.

Ambient Zero (Pin 10)
This pin is normally high. Hold it low for 1.5s to trigger an ambient zero. This assumes that the sensor is in fresh air (default setting is 450ppm).

6 Dynamic Power Requirements

Dynamic power requirements become important when operating from a USB port where the supply current might be being shared over several ports (we recommend using powered USB hubs to avoid these potential power issues) or when planning for low power applications like solar power.

When the power is applied to the sensor, initially a higher than normal operating current demand will occur. This inrush current and period will relate to the impedance of the power supply and device switching power.

The measurements below were taken whilst connected to a USB port via a USB to UART bridge cable, 3.3 volts, streaming / poled mode, same interval of measurement on a COZIR sensor

- Quiescent: 300 uA
- Measurement interval: 500 mS
- Measurement period: 20ms
- Measurement current: 30 mA
- RMS operating power: 2 uW
- Startup inrush current 50 mS @ 60 mA peaks

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