

## **AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR**

### **ABSTRACT**

The CozIR®-Blink is an ultra-low power NDIR CO<sub>2</sub> sensor using state-of-the-art solid-state LED optical technology. The CozIR®-Blink uniquely allows users to reduce the power consumption of CO<sub>2</sub> measurements to unprecedented levels by allowing the sensor to be power cycled, where the sensor is only powered-up for the duration of the measurement, and then powered down again to save power for battery powered or wireless interface applications.

The CozIR-Blink can be configured so power consumption is reduced down to microwatts per measurement. In such cases, it is important to consider not only how the sensor is powered-down, but also potential leakage paths from surrounding circuitry.

It is critical to ensure there are no current leakage paths, especially when the CozIR®-Blink is connected to a shared communications interface like an I<sup>2</sup>C bus. The purpose of this application note is to explain how to connect a GSS CozIR®-Blink CO<sub>2</sub> sensor to a host controller system and ensure there are no current leakage paths when the sensor is powered-off and not in use.

**AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING  
A COZIR®-BLINK CO<sub>2</sub> SENSOR**

**TABLE OF CONTENTS**

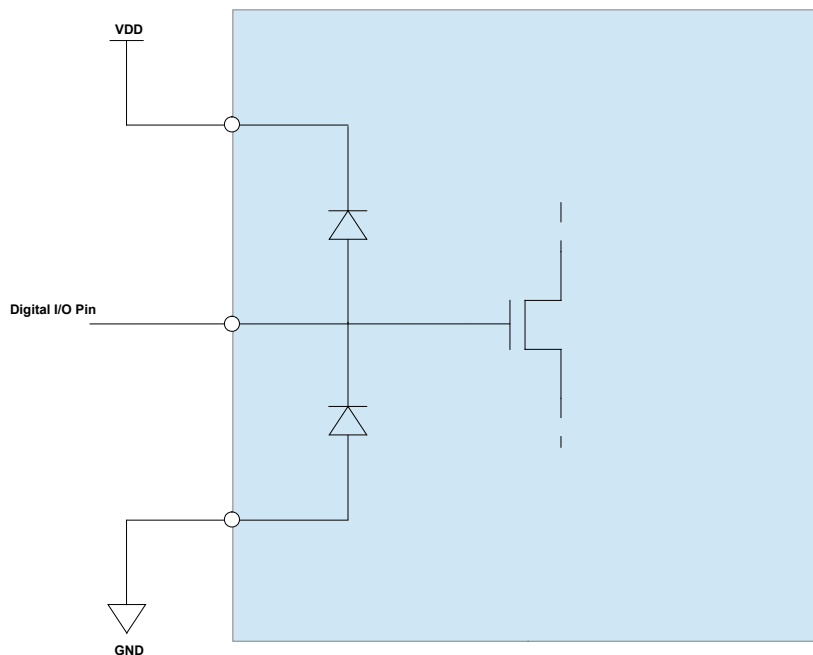
ABSTRACT .....	1
BASIC PRINCIPLES.....	3
CONNECTING WITH THE UART INTERFACE.....	4
CONNECTING TO AN I <sup>2</sup> C BUS .....	5
CHOICE OF SWITCH .....	7
POWER-OFF TIMING.....	7
CONCLUSION.....	7
IMPORTANT NOTICE.....	8
ADDRESS .....	8
REVISION HISTORY .....	9

## **AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR**

### **BASIC PRINCIPLES**

The CozIR-Blink sensor has two digital interface options, either I<sup>2</sup>C or UART. The interface is selected by reading the I2C\_ENABLE pin at switch on. If this pin is logic low (tied to ground), the I<sup>2</sup>C interface is selected. When the pin is logic high or not connected (pin has internal weak pull up), the UART interface is enabled. Only one interface type can be selected. The sensor needs to be switched off to enable the interface to be changed.

In a typical battery-controlled CO<sub>2</sub> measurement system using the CozIR®-Blink, it is important to isolate the sensor from the rest of the active circuitry when it is powered down. The communications interface on the CozIR-Blink is implemented using a microcontroller general purpose I/O port. Most microcontroller GPIO port pins have a similar structure with protection diodes to protect the internal circuitry from over voltage damage.



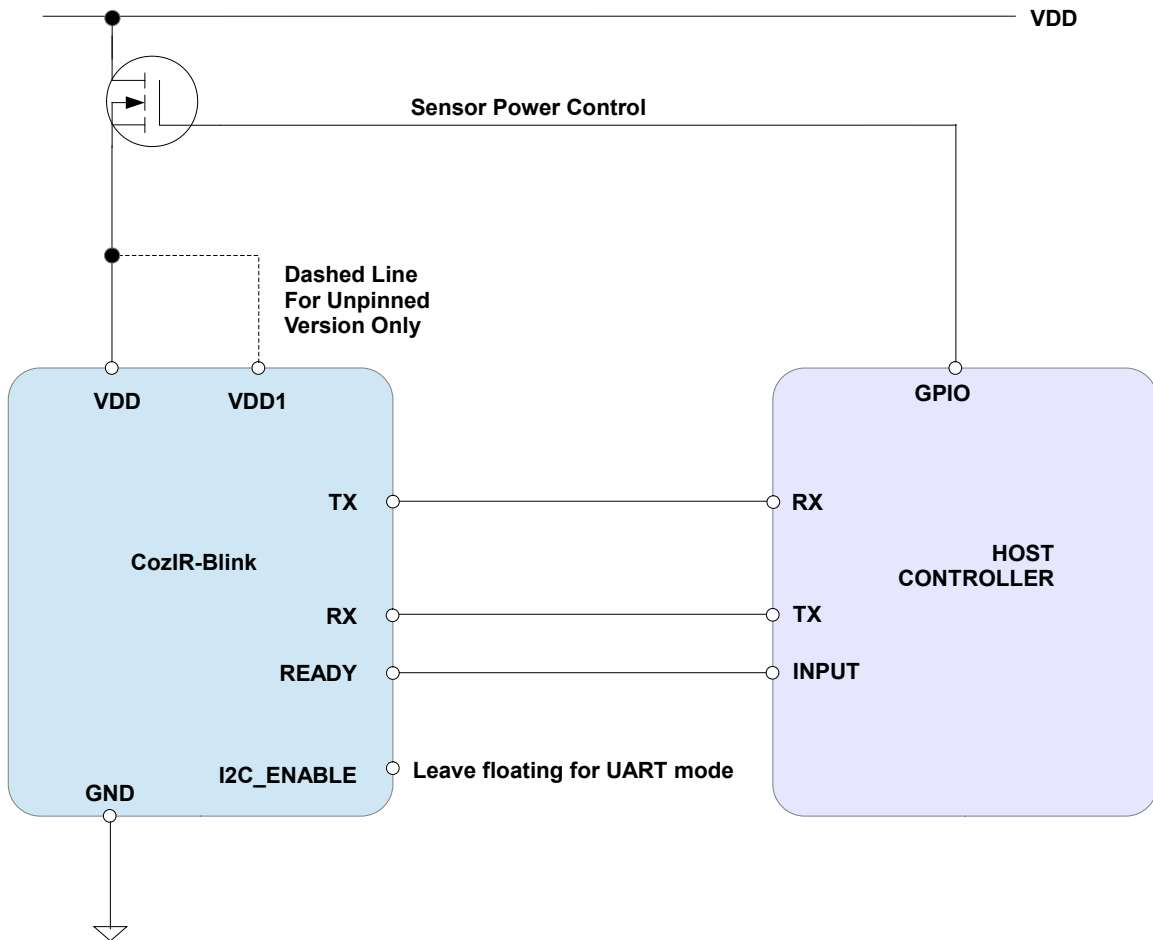
**Figure 1: GPIO protection diodes**

Figure 1 shows how the protection diodes are configured on a typical MCU GPIO pin. They are used to protect the microprocessor from voltages outside the operating range of the device. If the voltage at the GPIO input pin goes above VDD, the GPIO protection diode is forward biased and conducts. This scenario is a real possibility when the communications bus is still active but where the CozIR®-Blink is powered down and VDD is at 0V.

**AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR**

This means that power can be directed from the GPIO port pin to VDD and can potentially power up the sensor processor. The following pages detail how to overcome this issue.

**CONNECTING WITH THE UART INTERFACE**



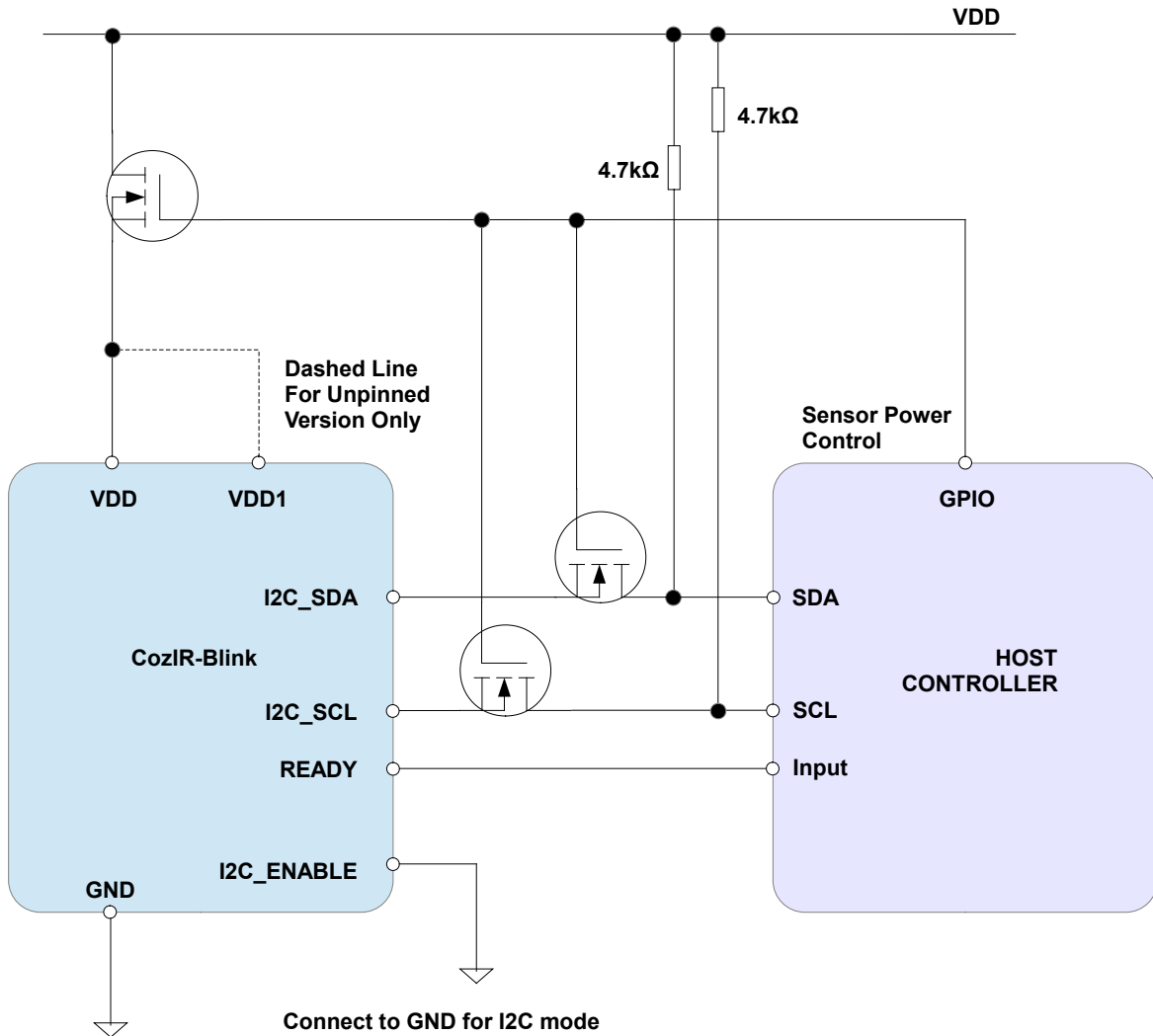
**Figure 2: UART connection**

Figure 2 shows the minimal connection for the CozIR®-Blink sensor in UART mode to allow the sensor to be completely turned off.

When the sensor is switched off, it is possible that power can leak from the host controller. To avoid this, it may be necessary to configure the Rx, Tx and Input pins of the host controller as high impedance or ensure they are not able to supply power. This may require the host controller to reconfigure the pin functions differently when the sensor is not in use.

**AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING  
A COZIR®-BLINK CO<sub>2</sub> SENSOR**

**CONNECTING TO AN I<sup>2</sup>C BUS**



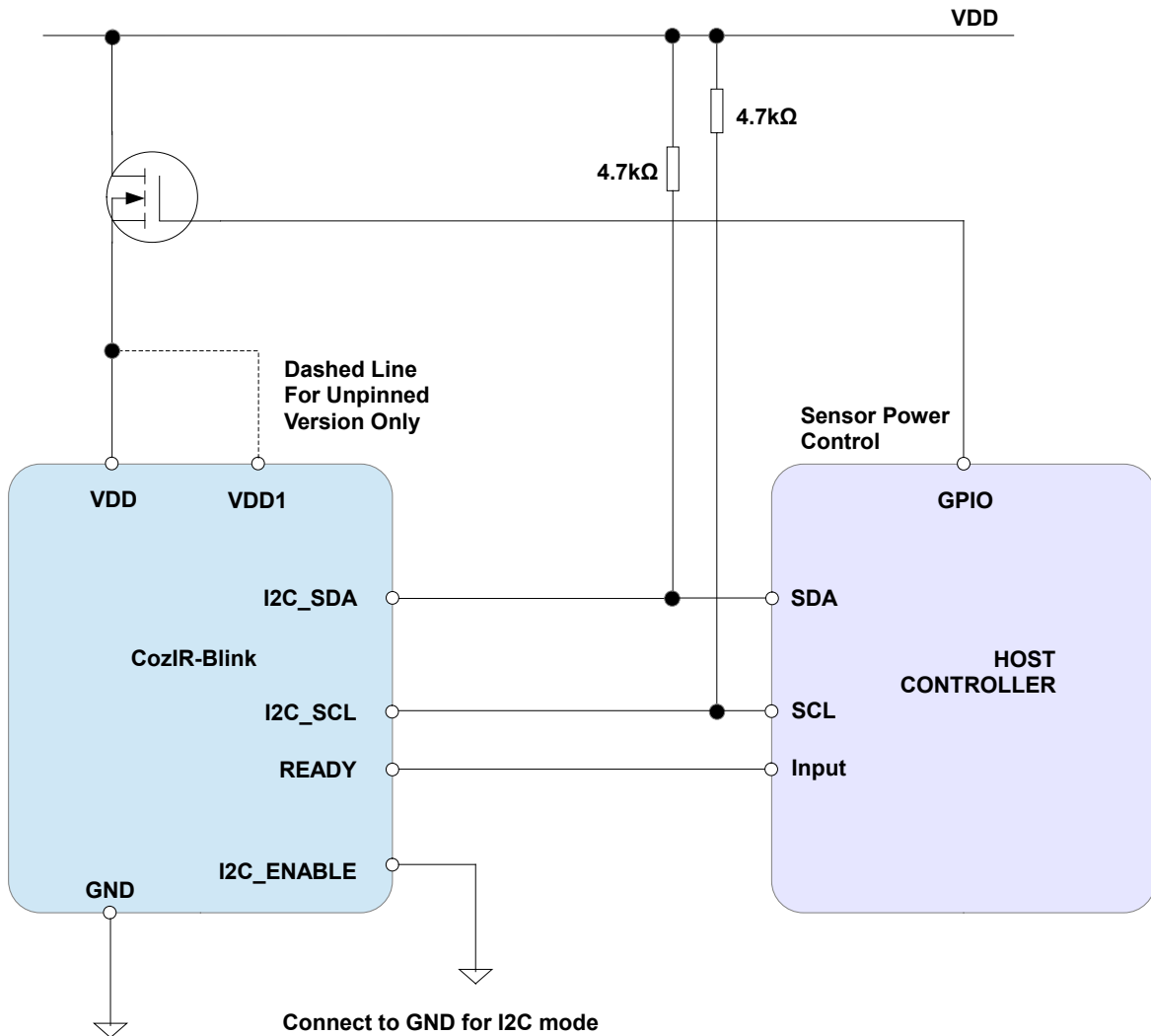
**Figure 3: I<sup>2</sup>C with shared bus**

When communicating with the CozIR®-Blink sensor using the I<sup>2</sup>C, there are two minimal circuit configurations depending on how the sensor is used within the overall.

Figure 3 shows what is required to isolate the CozIR®-Blink when it is powered off and there are other devices on the I<sup>2</sup>C bus. If the I<sup>2</sup>C lines are not isolated, the activity on the bus will cause the protection diodes on the sensor interface to conduct, and current will leak via the I<sup>2</sup>C pull up resistors into the sensor. This will waste power and also potentially corrupt I<sup>2</sup>C communications with other devices in

**AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR**

the system. While the sensor is powered off and the I<sup>2</sup>C bus is isolated, the I<sup>2</sup>C host controller can continue communicating with other devices and sensors in the system.



**Figure 4 I<sup>2</sup>C with dedicated bus**

Figure 4 is a potential option to reduce component count, but the CozIR®-Blink sensor must be the only device on the I<sup>2</sup>C bus. In this configuration, the I<sup>2</sup>C pullup resistors are only enabled when the sensor is powered up. Depending on the I<sup>2</sup>C function of the host controller system, it may also need to be disabled when the sensor is powered off. If the data and clock lines are low, this may result in continual I<sup>2</sup>C service interrupt requests.

## **AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR**

### **CHOICE OF SWITCH**

It is important to choose the correct type of switching MOSFET designed for high efficiency power management applications. Suitable devices have a low  $R_{DS\ ON}$  resistance and low OFF leakage current.

### **POWER-OFF TIMING**

The CozIR®-Blink is designed to be configured once, and then left to operate autonomously. The CozIR®-Blink was designed to be powered off as soon as the measurement is read from the sensor. However, if the configuration settings are modified or if other functions are enabled after a reading is taken, sufficient time must be allowed for the data changes to be written into flash memory on the sensor before powering it down. The period between changing a setting on the sensor and a safe shut down is specified in the data sheet.

### **CONCLUSION**

The CozIR®-Blink is designed for applications where ultra-low power consumption is paramount. To minimise power consumption, the CozIR®-Blink is designed to be turned off when not taking CO<sub>2</sub> measurements.

When designing a circuit to switch the sensor power on and off, it is important to consider if there are any residual current leakage paths that may consume power, particularly when the sensor is being used on a shared bus system. Even though this residual current leakage may be small in absolute terms, it can seriously impact the overall system power budget of the CozIR®-Blink measuring system unless appropriate steps are taken to properly isolate the sensor.

# AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING A COZIR®-BLINK CO<sub>2</sub> SENSOR

### IMPORTANT NOTICE

Gas Sensing Solutions Ltd. (GSS) products and services are sold subject to GSS's terms and conditions of sale, delivery and payment supplied at the time of order acknowledgement. GSS warrants performance of its products to the specifications in effect at the date of shipment. GSS reserves the right to make changes to its products and specifications or to discontinue any product or service without notice.

Customers should therefore obtain the latest version of relevant information from GSS to verify that the information is current. Testing and other quality control techniques are utilised to the extent GSS deems necessary to support its warranty. Specific testing of all parameters of each device is not necessarily performed unless required by law or regulation. In order to minimise risks associated with customer applications, the customer must use adequate design and operating safeguards to minimise inherent or procedural hazards. GSS is not liable for applications assistance or customer product design. The customer is solely responsible for its selection and use of GSS products. GSS is not liable for such selection or use nor for use of any circuitry other than circuitry entirely embodied in a GSS product.

GSS products are not intended for use in life support systems, appliances, nuclear systems, or systems where malfunction can reasonably be expected to result in personal injury, death or severe property or environmental damage. Any use of products by the customer for such purposes is at the customer's own risk.

GSS does not grant any licence (express or implied) under any patent right, copyright, mask work right or other intellectual property right of GSS covering or relating to any combination, machine, or process in which its products or services might be or are used. Any provision or publication of any third party's products or services does not constitute GSS's approval, licence, warranty, or endorsement thereof. Any third party trademarks contained in this document belong to the respective third-party owner.

Reproduction of information from GSS datasheets is permissible only if reproduction is without alteration and is accompanied by all associated copyright, proprietary and other notices (including this notice) and conditions. GSS is not liable for any unauthorised alteration of such information or for any reliance placed thereon.

Any representations made, warranties given, and/or liabilities accepted by any person which differ from those contained in this datasheet or in GSS's standard terms and conditions of sale, delivery and payment are made, given and/or accepted at that person's own risk. GSS is not liable for any such representations, warranties, or liabilities or for any reliance placed thereon by any person.

### ADDRESS

Gas Sensing Solutions Ltd.  
Grayshill Road  
Cumbernauld  
G68 9HQ  
United Kingdom



**AN010: MINIMISING SYSTEM POWER CONSUMPTION WHEN USING  
A COZIR®-BLINK CO<sub>2</sub> SENSOR**

**REVISION HISTORY**

<b>DATE</b>	<b>RELEASE</b>	<b>DESCRIPTION OF CHANGES</b>	<b>PAGES</b>
27/08/2021	1.0	First revision	All