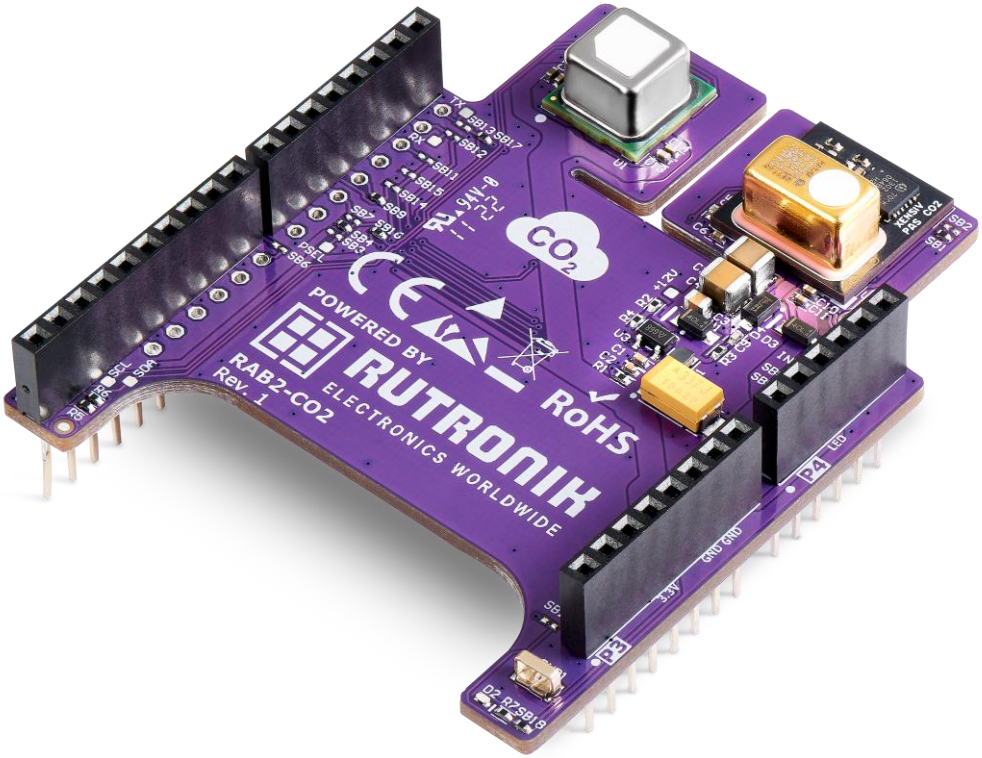
RAB2 – CO2 User Manual



Versions

Version	Date	Rationale
0	December 20, 2021	First draft.
1.0	April 2022	Rev. 1 Release.
2.0	September 20, 2023	New structure, software and firmware description are added. Autor: KOA

Legal Disclaimer

The evaluation board is for testing purposes only and, because it has limited functions and limited resilience, is not suitable for permanent use under real conditions. If the evaluation board is nevertheless used under real conditions, this is done at one's responsibility;
any liability of Rutronik is insofar excluded.

Table of Contents

Overview

Features

RAB2–CO2 is an evaluation board that allows to familiarize with environmental CO_2 and relative humidity and temperature sensing using a quick measurement with two independent CO_2 sensors. It enables faster Time-to-Market for products where CO_2 and relative humidity and temperature measurements of air are needed. RAB2-CO2 was designed by Rutronik to promote the products provided by company suppliers.

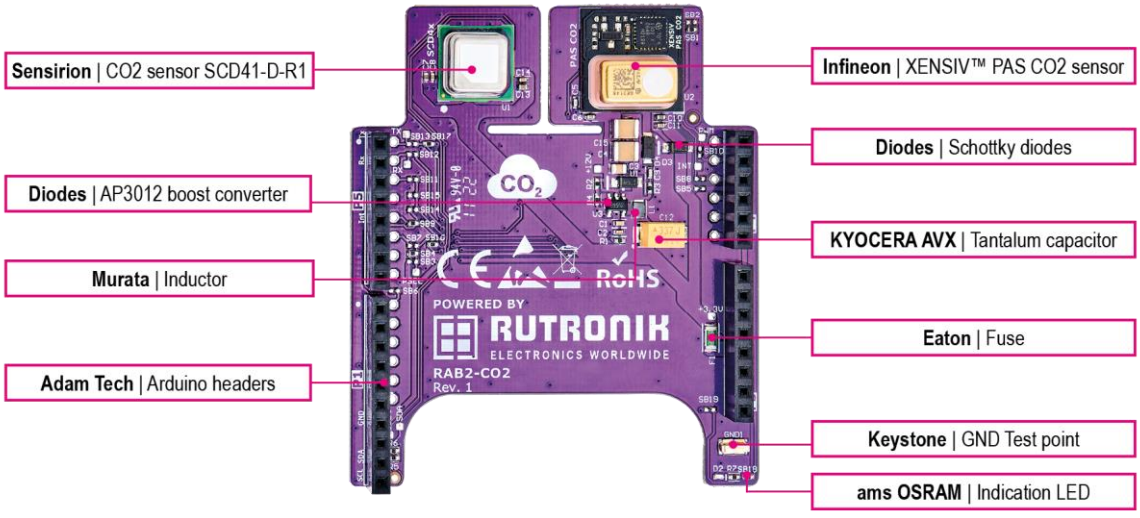
RAB2-CO2 is designed as Arduino compatible shield board. It is stackable to incorporate to complex evaluation system.

The board have the following features:

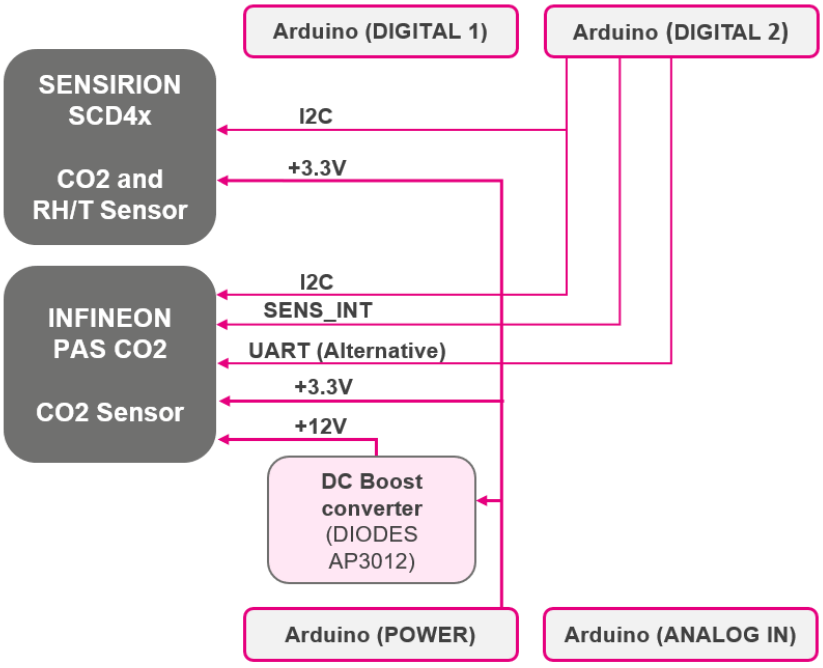
- Infineon CO_2 sensor.
- Sensirion CO_2 and RH/T sensor.
- Single supply 3.3V voltage.
- Adam-Tech Arduino compatible headers.
- Keystone test point.
- 12V integrated DC Boost converter for PAS CO2 sensor.
- Fuse protection.
- Indication LED.

Component Placement

The key CO_2 sensors are located in front of the board so CO_2 gas can easily reach sensitive area of sensors and avoid the obstacles.



Functional Block Diagram



There is main I2C bus for both sensors. PAS-CO2 sensor can be configured to UART communication or simple PWM output signal. This sensor has additional interrupt signal which has connection to Arduino GPIO connector.

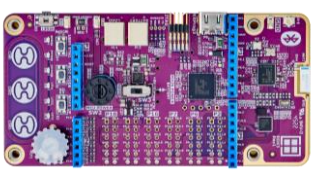
Applicable Boards

The following Rutronik System Solution boards are compatible with RAB2-CO2 and can be connected to it to provide the additional functionality.

RDK2

Evaluation of PAS CO2 and SCD41 sensors with the RDK3.
More details see here.

RDK3



Evaluation of PAS CO2 and SCD41 sensors with the RDK3.
More details see here.

Hardware

Power Sources

RAB2-CO2 board is powered from 3.3V single power supply through Arduino connectors. Alternatively, it can be powered from separate 3.3V and 12V directly without using boost converter. To do this, the following power selection configuration of SB5 solder bridge should be changed from default open to closed. The boost converter should be also disabled by changing solder bridge SB15 from open to close configuration.

Designator	Default Configuration (using DC-DC boost converter)	12V from Arduino Pins
SB5	Open	Closed
SB15	Open	Closed
SB11	Open	Open

Please pay attention to the selection of power source for Arduino compatible development board (RDK2, for example).

Power Consumption

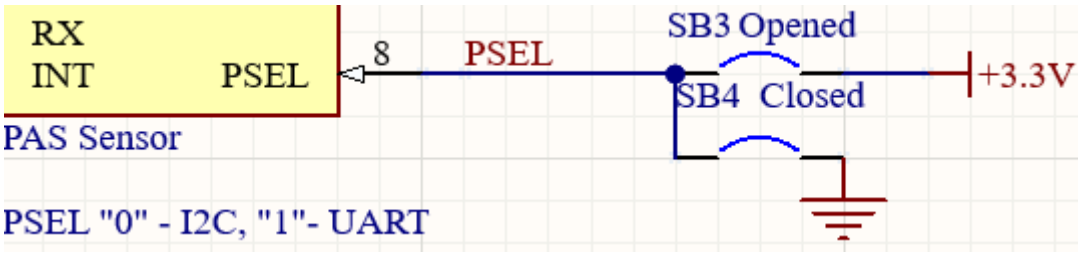
RAB2-CO2 board includes two CO_2 sensors. The measurements of both sensors depend on the measurement algorithm, it can be continuous or single. By default, continuous periodic measurement is performed for both sensors. The current ratings of sensors are shown in the table.

Sensor	Parameter	Voltage, Pin	Typical Value	Maximum Value
SCD-41-D-R2	Peak current (2)	3.3V, VDD	175 mA	205 mA
	Average current	3.3, VDD	15 mA	18 mA
PAS CO2	Peak current(1)	3.3V, VDD3.3	10 mA	20 mA
	Peak current (1)	12V, VDD12	130 mA	150mA
	Average current(1)	3.3V, VDD3.3	6.1mA	-
	Average current(1)	12V, VDD12	0.8mA	-
	Average power(1)	-	30mW	-
1) Based on datasheet. The current rating refers to 1 measurement/ 60 seconds as a typical sampling frequency. 2) Based on datasheet.				

There is a calculator that helps to estimate the power consumption, you can find it here.

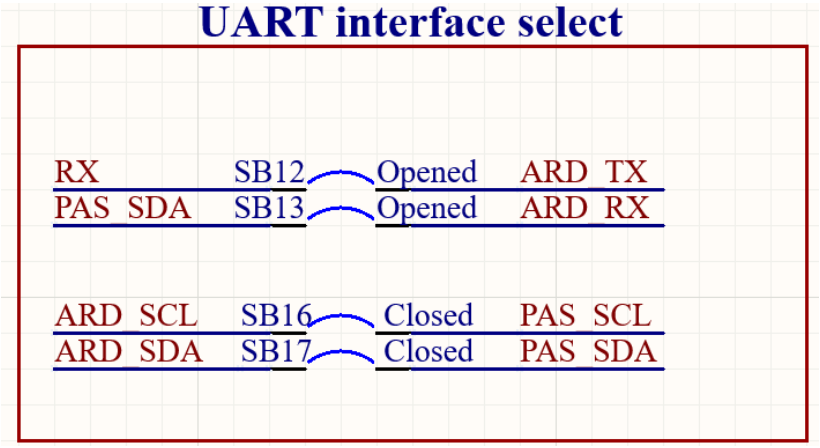
I2C/UART Interfaces

I2C is a default interface of RAB2-CO2. The PAS-CO2 interface can be configured by two solder bridges: SB3 and SB4. If SB3 is open and SB4 is closed, I2C interface is enabled; otherwise, UART is.



The I2C or UART interface can be also selected externally by the host microcontroller using a Pin 6 in Arduino header P5 “DIGITAL 2”. Please remove both solder bridges – the SB3 and SB4 before operation.

It is recommended to disconnect completely from the I2C interface before using the UART. To use the UART without any potential interferences that might come from the I2C pins, please unsolder the SB16, and SB17 and solder the SB12, and SB13 solder bridges.



The information about the configurations of solder bridges for different interfaces can be found in the table.

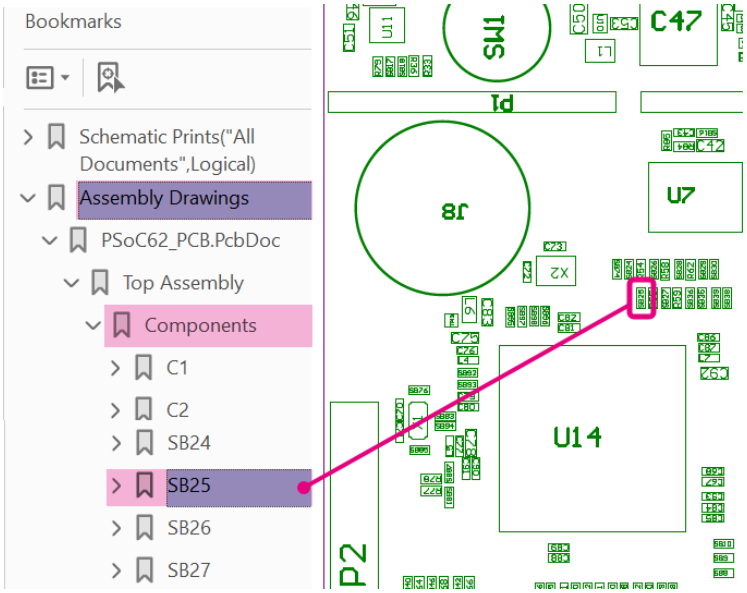
Solder Bridge Designation	Default Configuration (I2C communication)	Configuration for UART communication
SB3	Open	Open
SB4	Closed	Open
SB7	Open	Closed
SB12	Open	Closed
SB13	Open	Closed
SB16	Closed	Open
SB17	Closed	Open

Solder Bridges

The RAB2-CO2 board default configuration of solder bridges is described in table below. This configuration can be changed if needed.

Designation	Circuit	Default
SB1	PWM output enable	Closed
SB2	PWM output disable	Open
SB3	PAS CO2 interface selectin (I^2C)	Open
SB4	PAS CO2 interface selectin (UART)	Closed
SB5	12 V voltage enable trough Arduino pins	Open
SB6	PAS CO2 sensor interrupt output on Arduino header P1 pin 1	Open
SB8	PAS CO2 sensor interrupt output on Arduino header P4 pin 4	Open
SB9	PAS CO2 sensor interrupt output on Arduino header P5 pin 5	Closed
SB10	PAS CO2 sensor PWM output on Arduino header P4 pin 5	Open
SB11	12V boost converter control on Arduino header P5 pin 3	Open
SB12	PAS CO2 UART Rx input	Open
SB13	PAS CO2 UART Tx output	Open
SB14	PAS CO2 I2C SCL input	Closed
SB15	PAS CO2 I2C SDA data	Closed
SB16	Interrupt and 12V boost converter direct control	Open

The locations of the solder bridges can be found in 3D model and assembly drawings of RAB2-CO2.



How to find a component on the layout

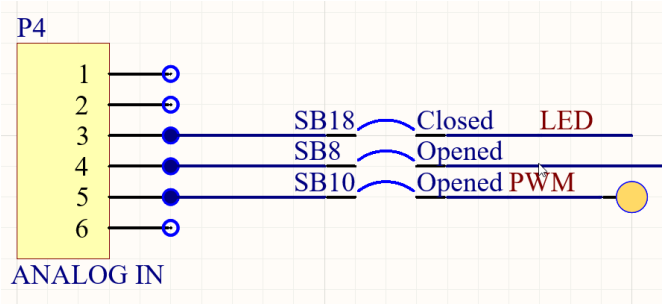
Arduino Connectors

The board contains Arduino connectors for open-source electronics prototyping platforms. Th following table represents all Arduino connectors and their description.

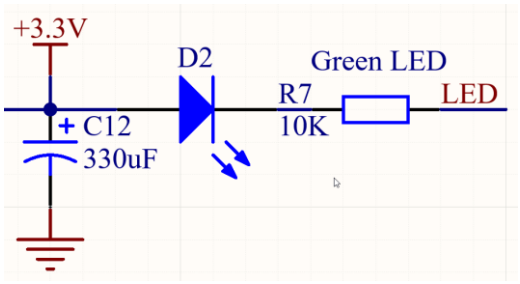
P1 (Digital) Pinout		
Pin No.	**Name**	**Description**
1	n.c. (SENS_IINT)	N.C. by default, alternative function is PAS CO2 sensor interrupt
2	n.c.	-
3	n.c.	-
4	n.c.	-
5	n.c.	-
6	n.c.	-
7	GND	Ground connection
8	n.c.	-
9	ARD_SDA	I^2C data
10	ARD_SCL	I^2C clock
P3 (Power) Pinout		
Pin No.	**Name**	**Description**
1	n.c.	-
2	n.c.	-
3	n.c.	-
4	3.3V	3.3 V DC power input (for low power operation)
5	n.c.	5 V DC power input
6	GND	Ground connection
7	GND	Ground connection
8	n.c. (12V)	N.C. by default, alternative function is PAS CO2 sensor 12V power input
P4 (Analog In) Pinout		
Pin No.	**Name**	**Description**
1	n.c.	-
2	n.c.	-
3	LED (n.c.)	Indication LED
4	n.c. (SENS_IINT)	N.C. by default, alternative function is PAS CO2 sensor interrupt
5	n.c.(PWM)	N.C. by default, alternative function is PAS CO2 sensor PWM output
6	n.c.	-
P5 (Digital2) Pinout		
Pin No.	**Name**	**Description**
1	n.c. (Tx)	N.C. by default, alternative function is PAS CO2 UART TX
2	n.c. (Rx)	N.C. by default, alternative function is PAS CO2 UART RX
3	n.c. (SHDN)	N.C. by default, alternative function is 12V DC boost converter enable signal
4	n.c.	-
5	n.c. (SENS_IINT)	PAS CO2 sensor interrupt output signal
6	n.c. (PSEL)	N.C. by default, alternative function PSEL - PAS CO2 interface selection
7	n.c. (LED)	N.C. by default
8	n.c.	-

Onboard LED

There is an indication LED, that is controlled by control board. By default, LED is connected to pin 3 of Analog In Arduino header P4.

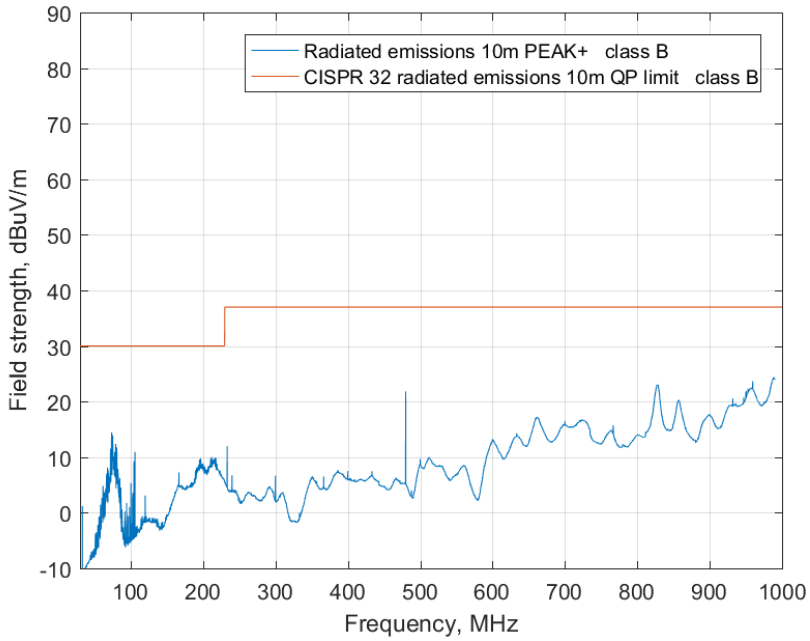


The location of LED on the board is shown below.



EMC TEST

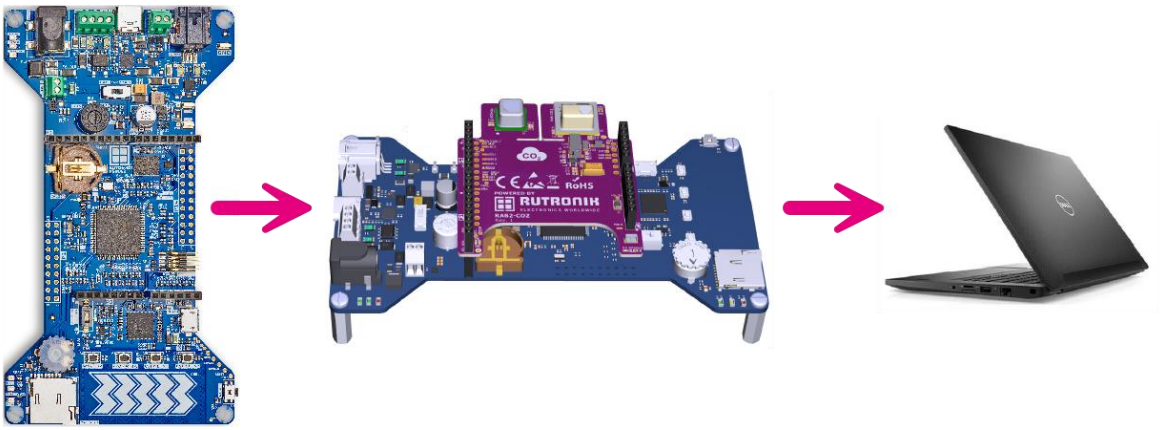
EMC radiated emissions of RAB2-CO2 board are shown below. The radiated emissions comply to CISPR 32 class B.



Software and Firmware

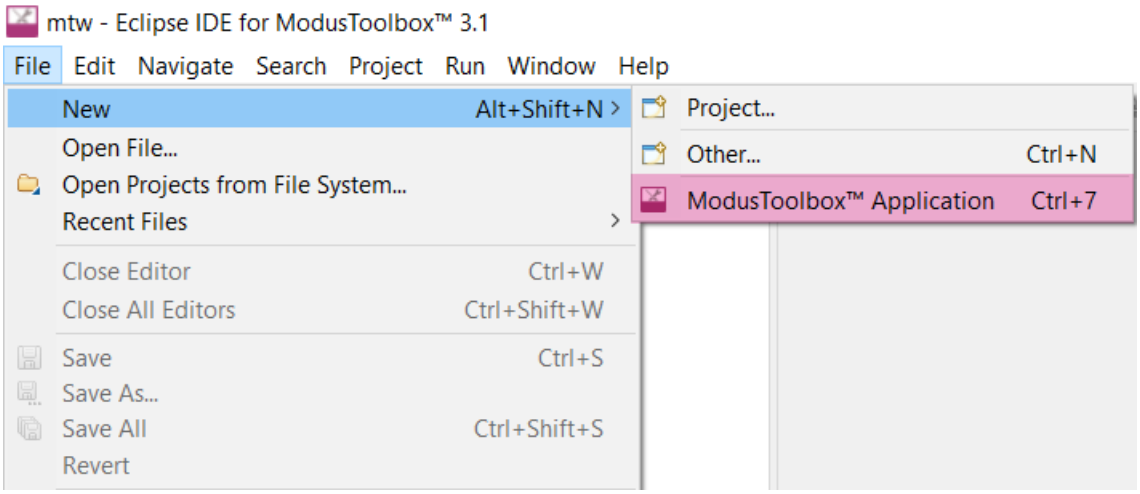
Getting Started

1. Register or/and login at Infineon website (myInfineon tab). License generation might take up to several days.
2. Download and install the latest version of ModusToolbox™ software.
3. Mount the RAB2-CO2 board on the RDK2 Arduino headers.
4. Ensure the switch SW1 of RDK2 is set to “3.3V” and connect the Micro USB cable to the “KitProg3” USB socket. Connect the RDK2 and CO2 assembly with a PC via cable.
5. Follow the procedure described in the paragraph “Running a Demo”.

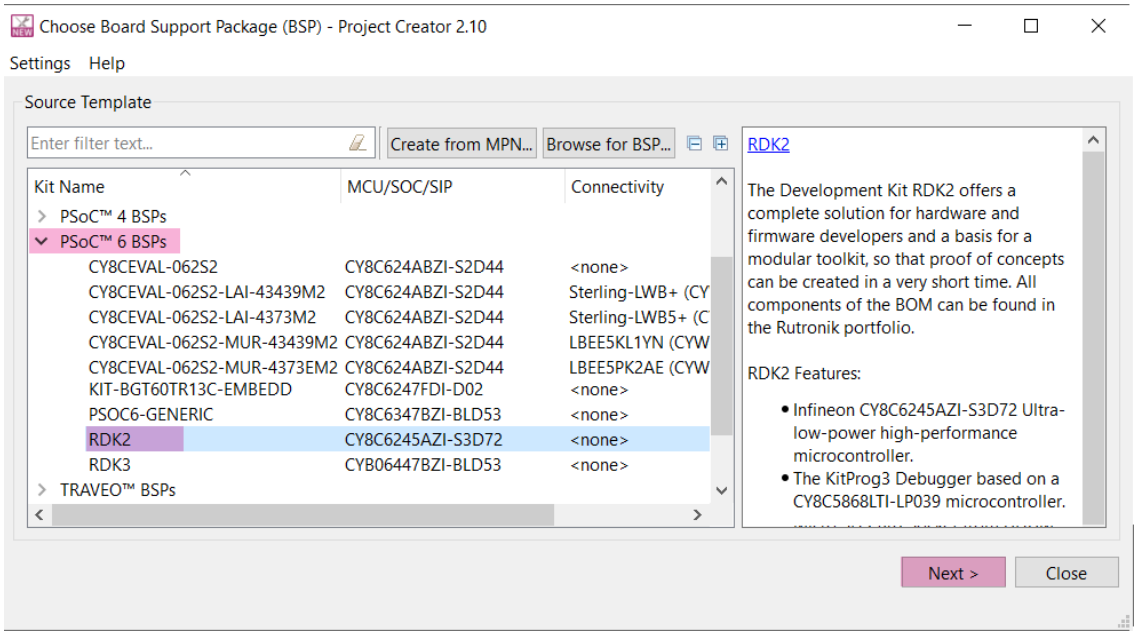


Running a Demo

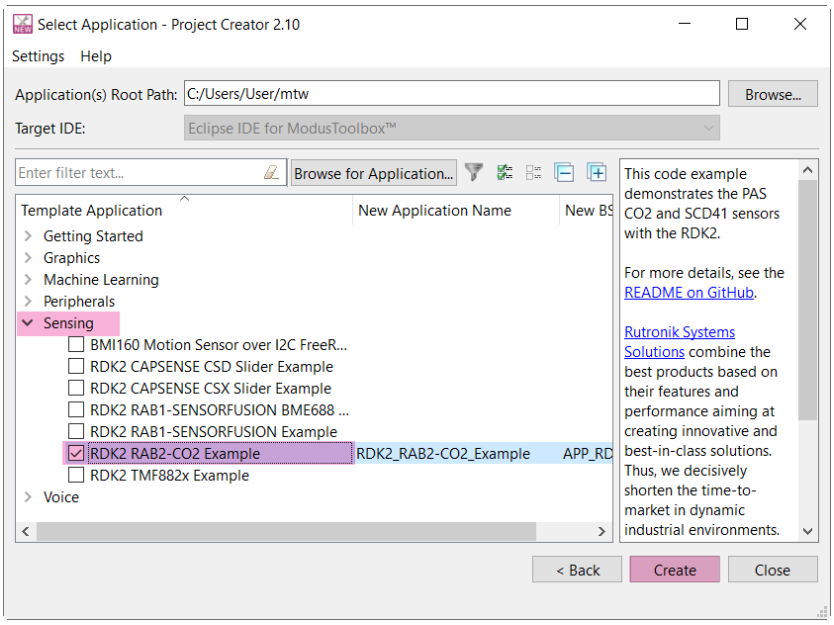
1. Run **Modus Toolbox** application.
2. Go **File** - **New** – **Modus Toolbox Application** and wait for a while.



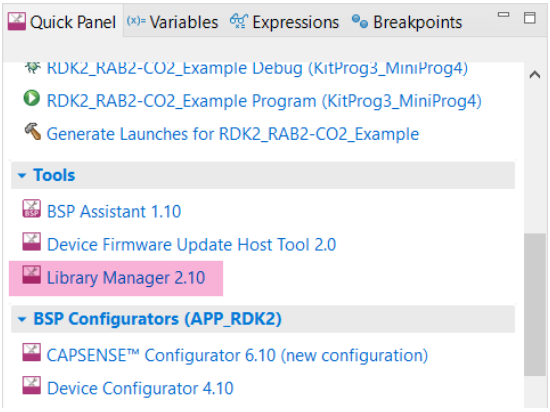
3. Open **PSoC 6** block, select **RDK2** and press **Next**.

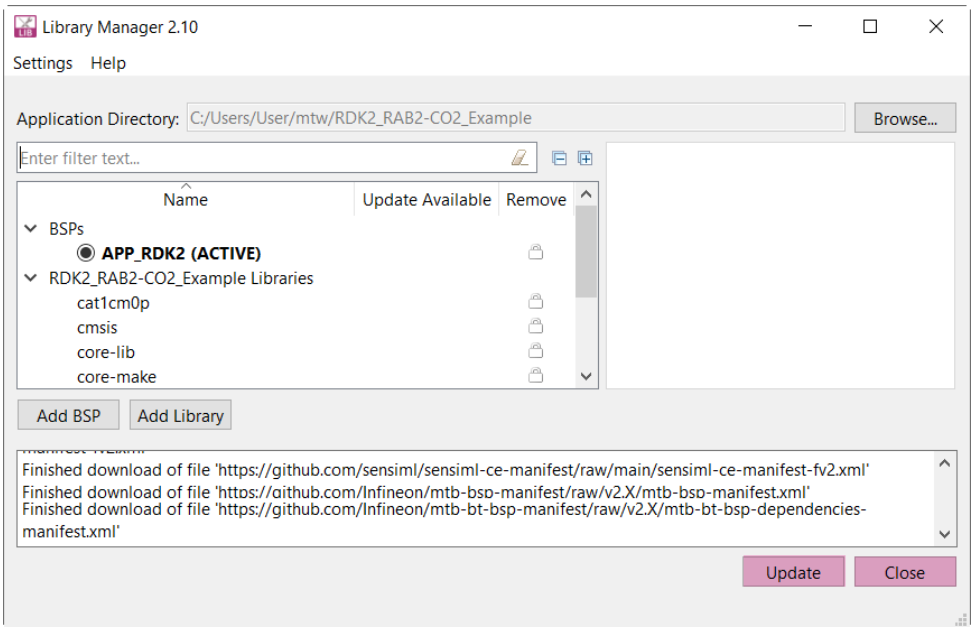


4. Open **Sensing** block, check **RDK2 CO2 Example** and press **Create**.

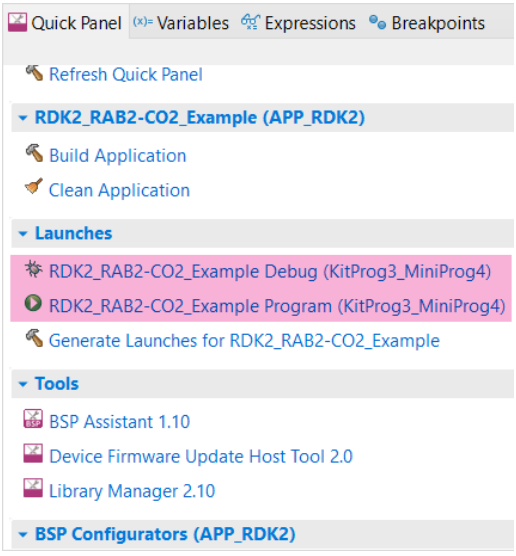


5. Open **Library Manager**, press **Update** and **Close** (this step is optional).

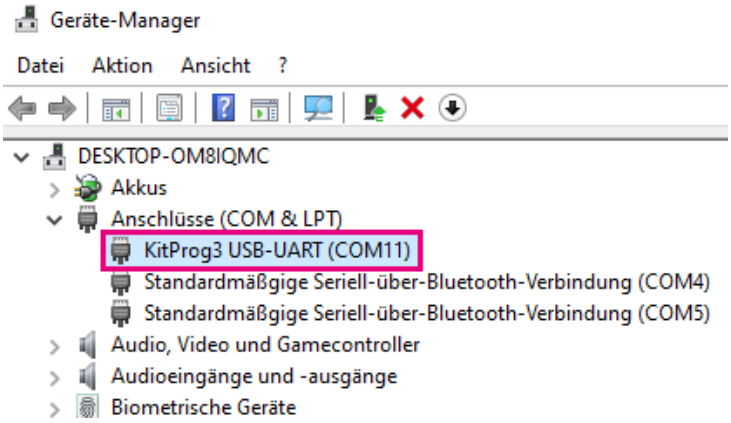




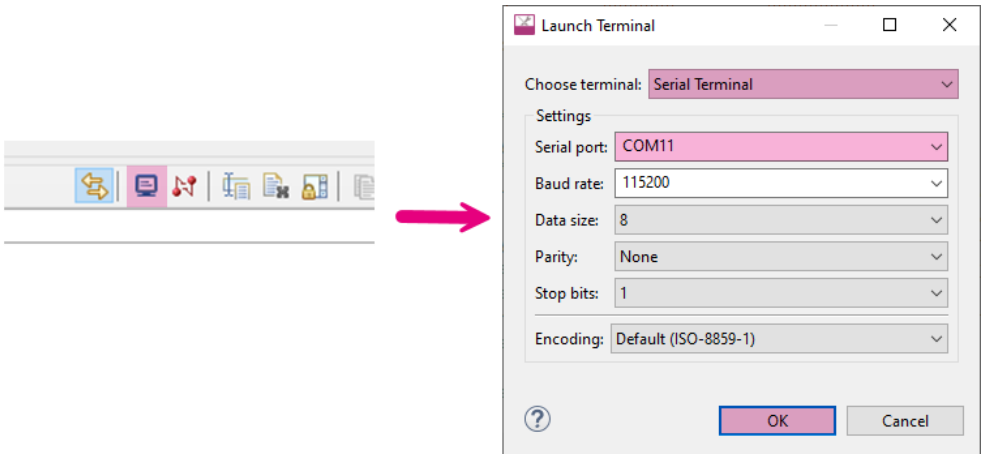
6. **Build** and **Debug** the project.



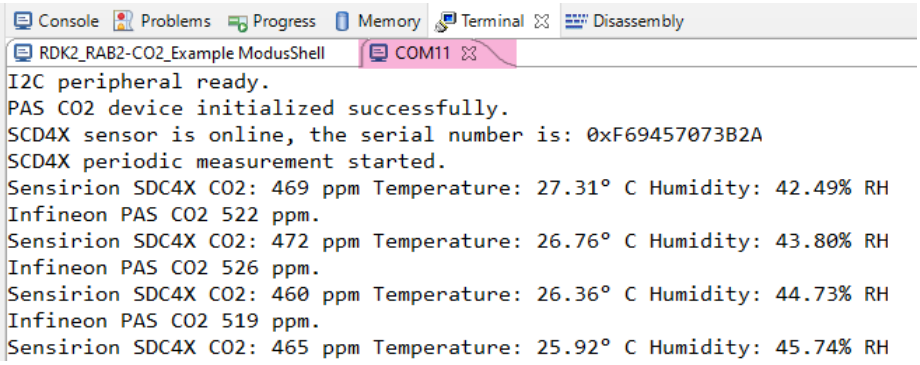
7. Check the number of KitProg3 COM port in Windows **Device Manger**.



8. Open **Terminal** tab, press **Open a Terminal**, select the serial port with the number from previous step and press **OK**.



9. The sensor data is refreshed every second in the COM terminal window.



Firmware Examples

All these examples can be found at GitHub.

RDK2_RAB2-CO2_Demo	This project demonstrates how RAB2-CO2 adapter board works together with RDK2.
RDK3_RAB2_CO2_Adapter_Demo	This firmware example running on the RDK3 initiates and tests the sensors on the RAB2-CO2 board.

Production Data

Schematics and Mechanical Layout

You'll find the schematics and mechanical layout of RAB2-CO2 here.

BOM

You'll find the BOM for RAB2-CO2 here.