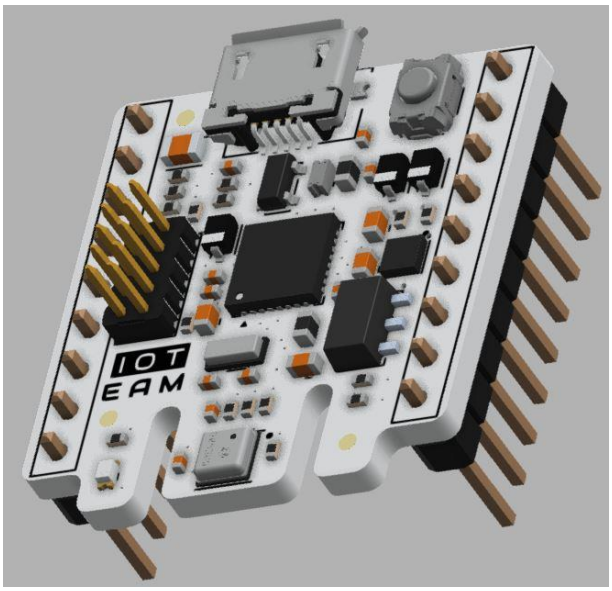

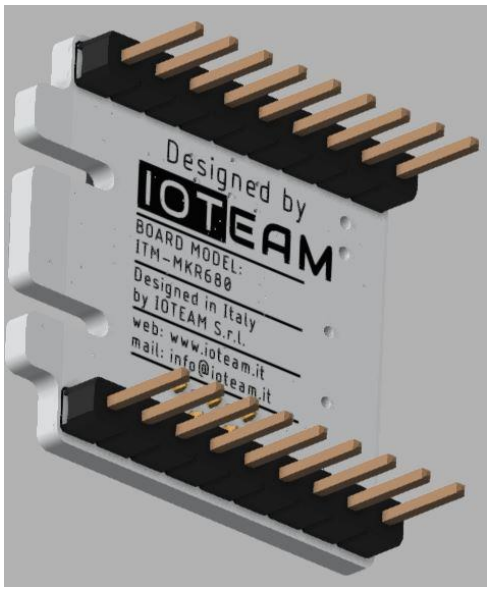

ITM-MKR680

User's Guide

All information contained in these materials, including products and product specifications, represents information on the product at the time of publication and is subject to change by IOTEAM S.r.l. without notice.

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Revisions

REVISION	DATE	DESCRIPTION	STATUS	AUTHOR	REVISER
Ver. 1.0	16/12/2017	First release	Draft	info@ioteam.it	
Ver. 1.3	19/05/2017	Pinout update	Release	info@ioteam.it	

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IOTEAM s.r.l.
Via Colzani 48 20831
Seregno (Monza Brianza)

info@ioteam.it
www.ioteam.it

1. Introduction

1.1. Description

The ITM-MKR680 board is a shield compatible with the new Arduino's MKR form factor.
It's based on the Bosch Sensortec BME680, an integrated environmental sensor that can detect a broad range of gases to measure indoor air quality for personal well being (VOC).
The BME680 it's also able to measure pressure, humidity and temperature.
Being equipped with an MHCP SAMD21, a low power Cortex-M0+, it's able to work in conjunction with any MKR form factor MCU as well as connected to an host or in standalone mode. The main purpose of the SAMD21 is to perform the processing of the data from the sensor, implementing the Bosch Sensortec analysis library.

The firmware of the ITM-MKR680 board can be customized using one of the following environments/tools:
- Arduino IDE via USB https://www.arduino.cc/en/Main/Software
- Arduino IDE + Atmel ICE
- Atmel Studio + Atmel ICE http://www.atmel.com/Microsite/atmel-studio/

1.2. Kit contents

The following items are included in the box:

1x MKR-680 Shield.

1.3. Getting started

The ITM-MKR680 can be used in conjunction with any MKR form factor MCU as well as connected to an host or in standalone mode.
ITM-MKR680 can exchange data with a Host through three metods:
- USB
- UART
- I2C

Please refer to the usage and software chapters to learn how to get started with the MKR-680 Shield and how to configure it.

2. System overview

2.1. Board layout

The layout of the MKR-680 board is shown in the picture below.

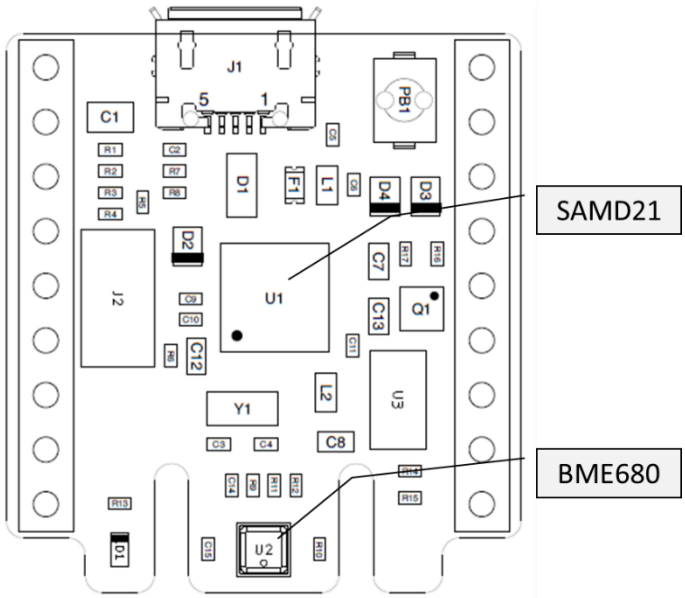

Figure 1 : ITM-MKR680 PCB board

2.2. Block diagram

An overview of the functions of the ITM-BME-680 board is shown in the figure below:

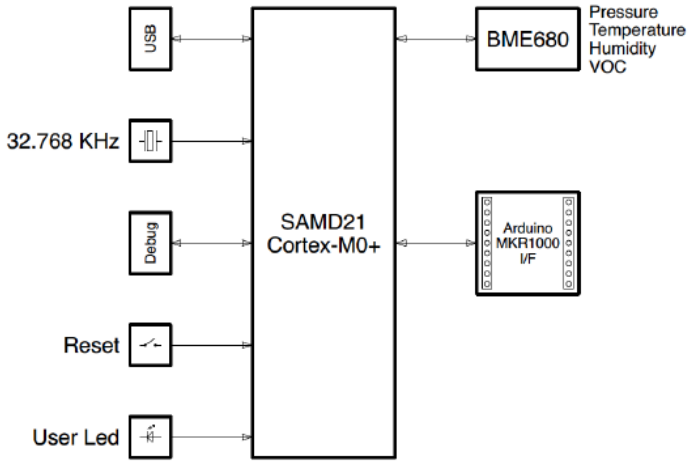

Figure 2 : IT-MKR680 block diagram

2.3. Board Specifications

Characteristics	Value
CPU Clock speed	48MHz
Flash Memory	256Kb
Connector	1 USB 1 SWD Debugger Arduino MKR100 Format compatible PinOut (18 pin)
Board supply voltage	3.3V CC (see chapter 4 for more details)
Temperature	-40°C to +85°C
Dimensions	24 mm x 26 mm

Table 1 : Board specifications

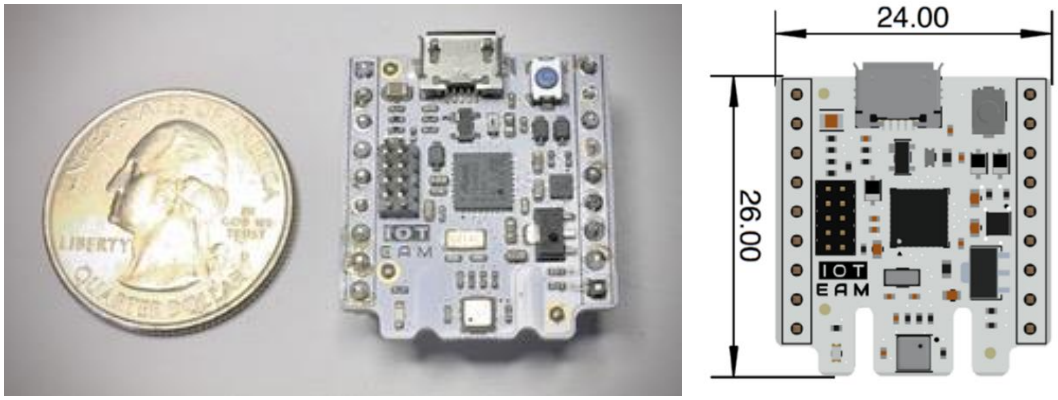

Figure 3 : ITM-MKR680 size

2.4. ATMEL SAMD21G18A low-power ARM

The Atmel SAMD21 Ultra low-power microcontroller using the 32-bit ARM® Cortex®-M0+ processor is the core of the entire board.

Memory

- 256KB in-system self-programmable Flash
- 32KB SRAM Main Memory

Clock Frequency

- 48 MHz using a 32.768kHz crystal oscillator (XOSC32K)

More information can be found on the ATMEL SAMD21 Data Sheet (See the link in the References and Useful Links chapter)

2.5. BME680 Integrated Environmental Unit

The BME680 is an integrated environmental sensor developed specifically for mobile applications and wearables where size and low power consumption are key requirements.

Expanding Bosch Sensortec's existing family of environmental sensors, the BME680 integrates for the first time individual high linearity and high accuracy sensors for gas, pressure, humidity, and temperature.

It consists of an 8-pin metal-lid 3.0 mm^3 x 3.0 mm^3 x 0.95 mm^3 LGA package which is designed for optimized consumption depending on the specific operating mode, long-term stability, and high EMC robustness.

The gas sensor within the BME680 can detect a broad range of gases to measure indoor air quality for personal well-being. Gases that can be detected by the BME680 include volatile organic compounds (VOC) from paints (such as formaldehyde), lacquers, paint strippers, cleaning supplies, furnishings, office equipment, glues, adhesives, and alcohol.

2.5.1. Features

- **RH**
  Measures relative humidity with a fast response time
- **Pressure**
  Measures barometric pressure and altitude
- **Temperature**
  Measures ambient temperature
- **Gas**
  Measures volatile organic compounds (VOC)

3. Connectors

This chapter gives you an overview of the MKR-680 connectivity. The connectors' placement is depicted in the figure below.

The ITM-MKR680 board occupies only partially the host's headers as follows:

Powered by 5V or 3.3V
Communication through I2C
Resettable via own button or from the host
Interrupts availability

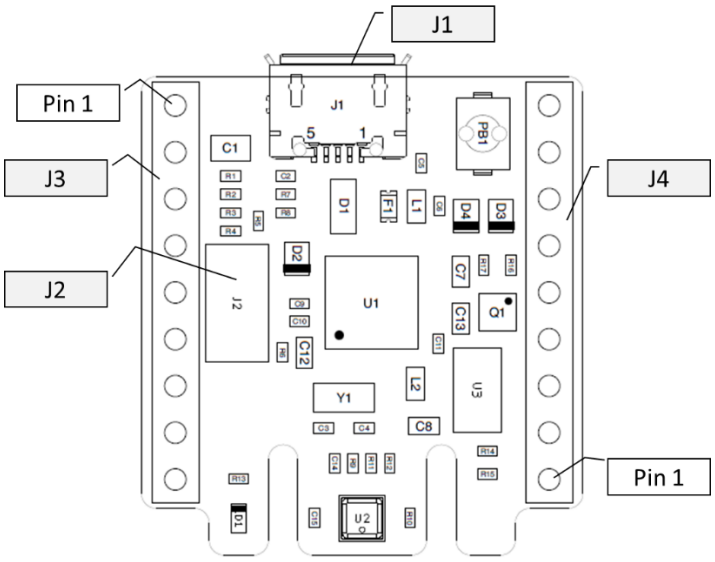

Figure 4 : MKR-680 connectors (front view)

ID	Connector	Side
J1	USB	front
J2	SWD Connector DEBUG	front
J3	Arduino MKR	
J4	Arduino MKR	

Table 2 MKR-680 connectors

3.1. USB CDC Uart interface

The board is equipped with a USB (J1) Full-Speed (12 Mbps) device port on USB Micro-b connector. ITM-MKR680 can be powered through this interface.

3.2. SWD Connector

The ITM-MKR680 board features an on-board SWD Connector (J2) that can be used to program and debug the microcontroller.

This connector should be used if you are not using the Arduino IDE programmable mode.

Use this connector with Atmel Studio development environment and the Atmel ICE probe.

Warning

Using SWD to download your application you override the Arduino boot loader

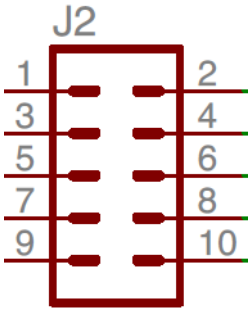

Figure 5 : SWD Connector

Name	Conn.	Pin
+3.3V	J2	1
SWDIO	J2	2
GND	J2	3
SWCLK	J2	4
GND	J2	5
PA10	J2	6
Not used	J2	7
PA11	J2	8
Not used	J2	9
RESET	J2	10

Table 3 SWD Connector

3.3. MKR format connectors

The MKR-680 can be use in different way. J3 and J4 connectors are used according to the difference purpose of usage. The table 4 show the pinout of the board when used as an Arduino CPU.

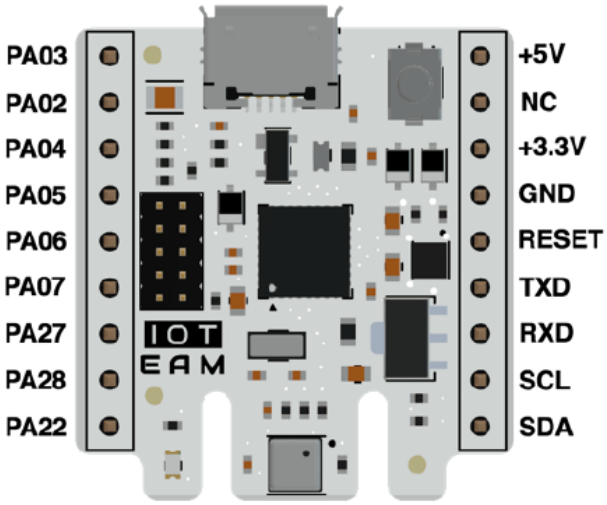

Figure 6 : Arduino MKR-680 pinout (front view)

MKR-680 as an Arduino board			
Name	**Conn.**	**Pin.**	**Description**
PA03	J3	1	AREF
PA02	J3	2	DAC0/A0
PA04	J3	3	A1
PA05	J3	4	A2
PA06	J3	5	A3
PA07	J3	6	A4
PA27	J3	7	D0
PA28	J3	8	D1
PA22	J3	9	D2
PA08	J4	1	D3 / SDA
PA09	J4	2	D4/ SCL
PA15	J4	3	D5 / RX
PA14	J4	4	D6 / TX
RST	J4	5	RESET
GND	J4	6	GND
+3.3V	J4	7	VCC 3.3V
NC	J4	8	Not connected
+5V	J4	9	+5V

Table 4 MKR-680 pinout mapping – as an Arduino CPU

When used as an Arduino Shield or as a stand alone sensor the only pins of J4 connector used are those providing power and I2C connections

MKR-680 as an Arduino Shield or as stand alone sensor		
Name	**Conn.**	**Pin.**
SDA	J4	1
SCL	J4	2
RESET	J4	5
GND	J4	6
+3.3V	J4	7
+5V	J4	9

Table 5 MKR-680 pinout mapping – as Shield or sensor

3.4. Connection diagram

Being equipped with an MHCP SAMD21, a low power Cortex-M0+, ITM-MKR680 is able to work in conjunction with any MKR form factor MCU as well as connected to an host or in standalone mode.

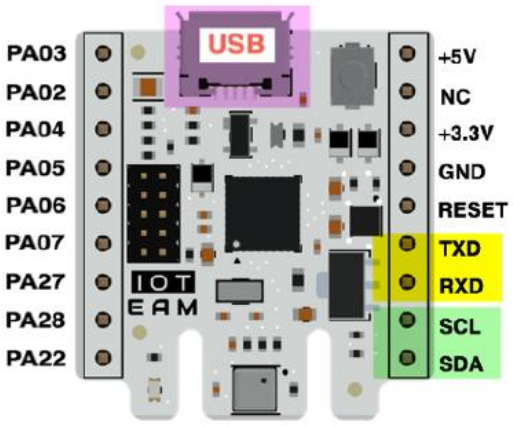

Figure 7 : Shield interface throught USB or UART or I2C

As shown in the previous figure:

- SCL and SDA allow the communication with another MCU board through an IIC interface (typically when used as a shield)
- USB interface can be used to connect the board with a host
- TXD and RXD allow an UART interface when used as an Arduino board (Firmware must be implemented by the user)

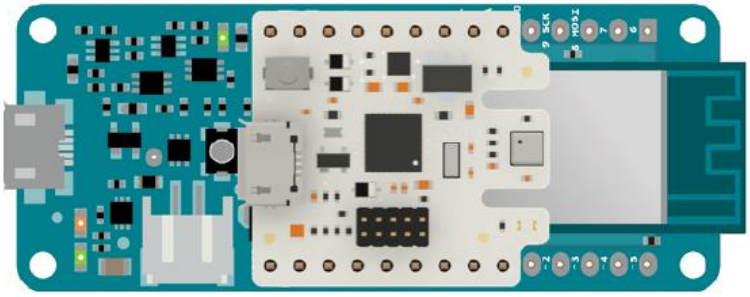

Figure 8 : Shield mounted on a MKRZERO form factor board

When ITM-MKR680 is mounted on a MKRZERO format board it is powered by the hosting board through Arduino Pin.

When used in stand alone mode is powered through USB or with a 5V or 3.3V dc at the 9 or 7 pin J4 connector listed in table 5, ground at pin 6.

Mind that internal power is always 3.3V.

4. Usage

This chapter describes how to connect, configure and interact with the Shield.

The ITM-MKR680 board is compatible with the MKR form factor MCUs.

The ITM-MKR680 can exchange data with a Host through:

- USB
- UART
- I2C

The ITM-MKR680 is pre-programmed with an application FW that includes the Bosch BME680 library and the I2C communication with the Host.

4.1. Power supply

The ITM-MKR680 can be powered alternatively through:

- USB connector
- +5V through J4 connector
- +3.3V through J4 connector

The various power supplies can be applied simultaneously without conflicts.

4.2. LED

A basic user interface is provided through on-board LED

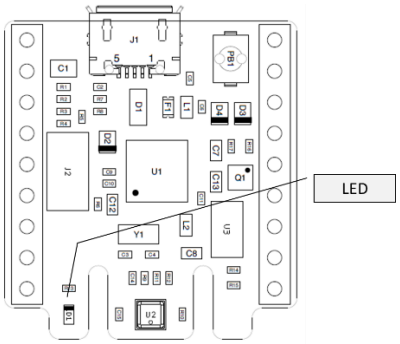

Figure 9 : Push button & LED

OBJECT	DESCRIPTION	COLOR	SAMD21 Port
LED 1	User LED	amber	PA23

Table 6 Push button & LED

5. Getting Started with Arduino IDE and Sketch Projects

5.1. Tools

The following tools are needed:

- Arduino IDE (Release 1.6.4 or newer)
- USB cable

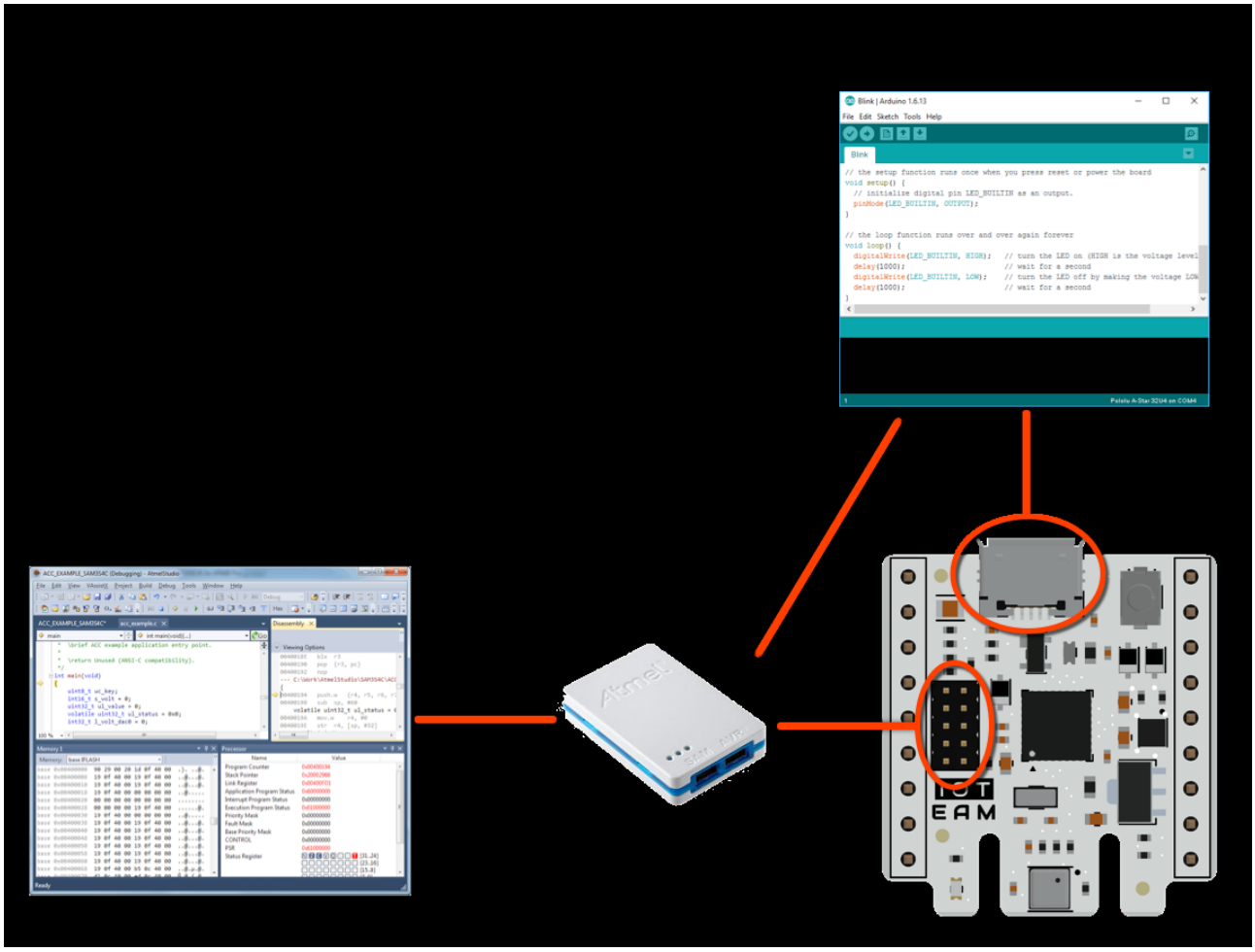

Figure 10 : Launch Board Manager

5.2. Importing the components Library

In order to use the MKR680 with factory firmware, a specific library is required. To install the Library go to the GitHub repository, download and extract on arduino library folder the zip file.

- MKR680-SH-library (https://github.com/midatronics/MKR680-SH-library)

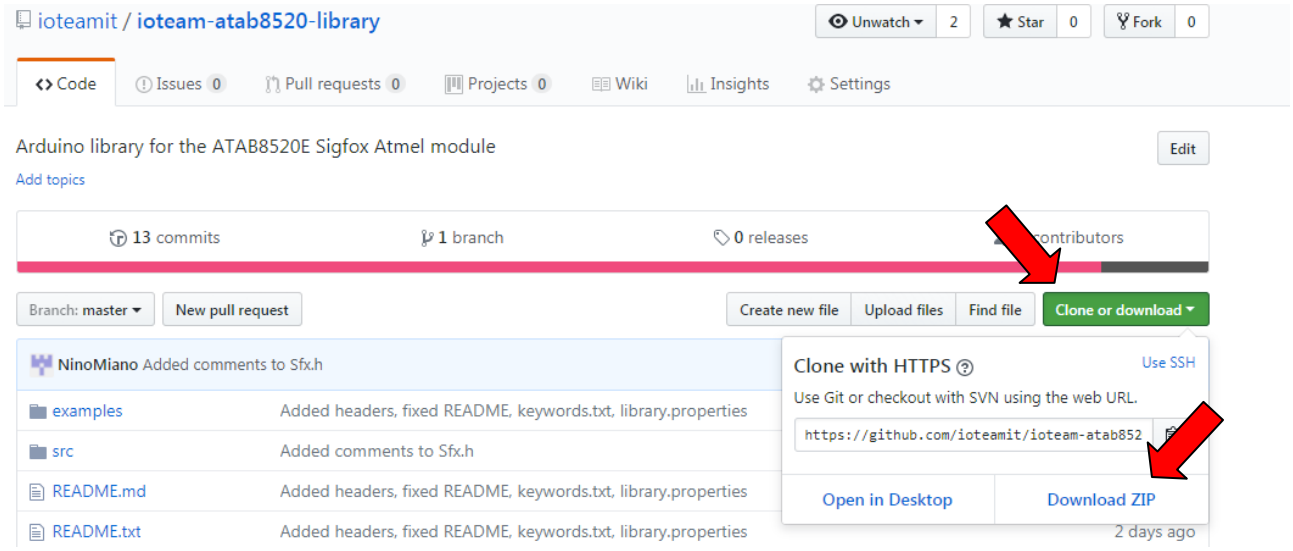

Figure 11 : GitHub libraries repository

Once it is downloaded, go to the "include Library" menu and use the "Add .ZIP Library…" item.

6. Exsample

Plug the ITM-BME-680 on any MKR format board end copy end paste the arduino example code to put on usb the parameter read from sensor.

Code:

```
/**************************************************************
 * Sketch Demo mkr680 for IOTEAM Dustino
 *            Created By Amanu95
 * email: Emanuele.mancuso@midatronics.com
**************************************************************/
```

```
#include <Arduino.h>
#include <Wire.h>
#include <MKR680.h>
#define timeToDelay 4000
long timesent=0;
BME680_data data, *datasend;
bool newdatatosend = false;
/*********************************************
 ******* SETUP
*********************************************/
void setup() {
  SerialUSB.begin(115200);
  Wire.begin();
  BME680.begin();
  delay(100);
}
/*********************************************
 ******* LOOP
*********************************************/
void loop() {
  if(millis()>timesent){
    if (BME680.available()) {
        data = BME680.read();
        SerialUSB.print("Timestamp         : ");
        SerialUSB.print((float) data.timestamp / 1000.0);
        SerialUSB.println(" sec");
        SerialUSB.print("Temperature (RAW) : ");
        SerialUSB.print(data.temperature);
        SerialUSB.print("°C (");
        SerialUSB.print(data.rawTemperature);
        SerialUSB.println("°C)");
        SerialUSB.print("Pressure          : ");
        SerialUSB.print(data.pressure);
        SerialUSB.println(" hPa");
        SerialUSB.print("Humidity (RAW)    : ");
        SerialUSB.print(data.humidity);
```

```
      SerialUSB.print("% (");
      SerialUSB.print(data.rawHumidity);
      SerialUSB.println("%)");
      SerialUSB.print("Gas resistance    : ");
      SerialUSB.print(data.gasResistance);
      SerialUSB.println(" Ohm");
      SerialUSB.print("IAQ (accuracy)    : ");
      SerialUSB.print(data.iaqEstimate);
      SerialUSB.print(" (");
      SerialUSB.print(data.iaqAccuracy);
      SerialUSB.println(")");
      SerialUSB.println();
    }
    else{
      SerialUSB.println("BME680 not connected");
    }
    timesent=millis()+timeToDelay;
  }
}
```

7. References and Useful Links

7.1. Data sheets

ATMEL SAMD21 Ultra low-power ARM® Cortex®-M0+ D21
http://www.atmel.com/Images/Atmel-42181-SAM-D21_Datasheet.pdf

BOSH BME680
https://cdn-shop.adafruit.com/product-files/3660/BME680.pdf

7.2. Tools

- Arduino IDE -https://www.arduino.cc/en/Main/Software
- Atmel Studio -http://www.atmel.com/microsite/atmel-studio/

7.3. Web Sites

- IOTEAM S.r.l. -www.ioteam.it
- Arduino -www.arduino.cc
- Atmel -www.atmel.com
- Bosh -www.bosch-sensortec.com/en/bst/products/all_products/bme680

8. Troubleshooting

8.1. Driver installation problems

It can happen that the installation of the driver does not automatically complete successfully. The driver to manage the COM Port is not installed properly and the device is reported as an Unknown Device.

If this happens, it is necessary to install the driver manually.

The correct drivers can be found on the following directory:

C:\Users\<**login name**> \AppData\Local\Arduino15\packages\Arrow\hardware\samd\<**installed Rel**>\drivers.

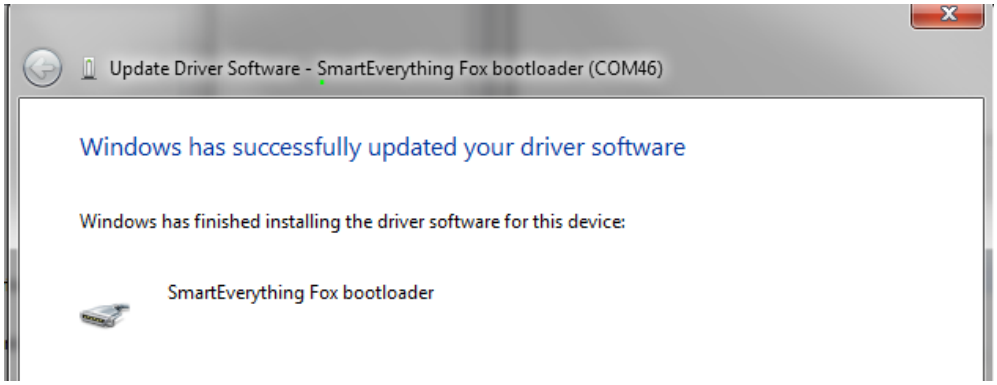

Figure 12 : Correct USB Driver installation