1. Project title: XMC 2Go Barometric Sensor Interfacing

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2. Abstract

Barometric pressure has a large scale usage in industrial applications. It is used in weather determination, car wheels pressure, altimeters, smartphones and more.

3. Introduction, project aims and objectives

This project proposes to use an industrial level barometric sensor pressure from Infineon (KP235). The output of the sensor will be read by a XMC2Go development board. The purpose of this project is to learn how to use Infineon Dave IDE and how to develop applications using Dave components.

4. System overview

To develop this project I chose to use a XMC2Go development board from Infineon along with the KP235 barometric sensor.
The XMC2Go is intended for small devices which need processing power and small consumption (wearable devices).
KP235 is an analog pressure sensor which can measure from 40 kPa to 115 kPa pressure (0.5V to 4.5 V) with high precision. In this system I used P2.0 analog input from development board to read the output of the sensor.

5. Schematics and components

XMC2Go:

The XMC 2Go is designed to evaluate the capabilities of the XMC1100 Microcontroller and the powerful, free of charge tool chain DAVE

1.1 Key Features

Table 1 summarizes the features of the XMC 2Go.

Table 1 Features of the XMC 2Go Kit with XMC1100

Topic	Features
Processor	XMC1100 microcontroller (ARM® Cortex™-M0 based) in a 4 x 4 mm VQFN-24 package
Flash	64 kB
RAM	16 kB
Clock Generation	Internal Oscillator
Frequencies	32 MHz CPU clock, 64 MHz Timer clock
Dimensions	14.0 x 38.5 mm
Power Supply	• from USB via Debug probe (J-Link) or • 3.3V external power
Connectors	Two 8-pin header (pin pitch: 2.54 mm ≙ 0.1" / between rows: 10.16 mm ≙ 0.4") Pin header fits to breadboard
Debugger	On-Board J-Link Debugger supports • Serial Wire Debug (SWD, ARM Standard) • Single Pin Debug (SPD) • UART-to-USB bridge (virtual COM)
Peripherals	Mapped to pin header X1/X2: • 2 Channel USIC (UART, SPI, I2C, I2S, LIN) • 6 Channel Analog to Digital Converter (12-Bit resolution) • 4 x 16-Bit Timer • External Interrupts (via ERU) Others: • Real Time Clock • Random Number Generator
Others	2 User LEDs @ P1.0 and P1.1

1.2 Block Diagram The block diagram in Figure 1 shows the main components of the XMC 2Go Kit including the power supply concept. There are following main building blocks:

- XMC1100 Microcontroller in a 4x4mm VQFN24 package
- On-board USB debugger realized with a XMC4200 Microcontroller for serial wire debug (SWD) and UART-to-USB Bridge
- Two 8 pin header X1 and X2
- On-board power generation for power supply of the XMC1100 Microcontroller and the debug IC 2 User LEDs

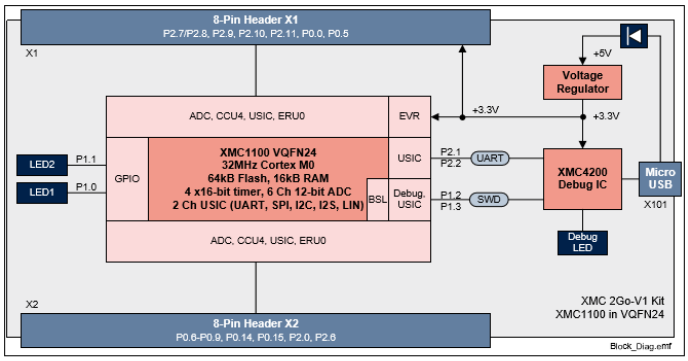


Figure 1 Block Diagram of the XMC 2Go Kit

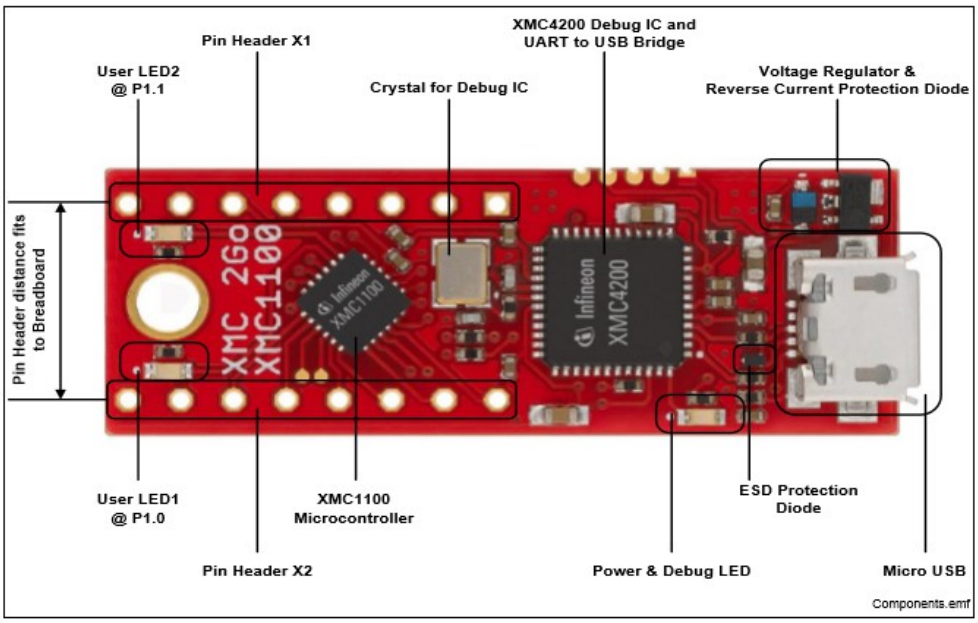
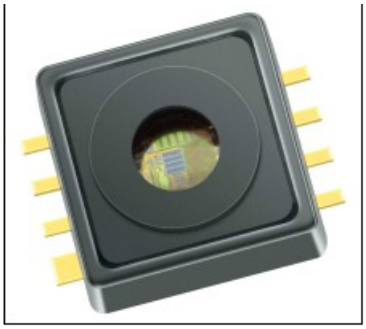


Figure 2 XMC 2Go Kit with XMC1100

KP235 barometric sensor:

Product Description

The KP235 is a miniaturized Analog Barometric Air Pressure Sensor IC based on a capacitive principle. The sensor converts a pressure into an analog output signal. The calibrated transfer function converts a pressure of 40 kPa to 115 kPa into a voltage range of 0.5 V to 4.5 V. The chip is packaged in a “green” SMD housing. The sensor has been primarily developed for measuring barometric air pressure, but can also be used in other application fields. The high accuracy and the high sensitivity of the device makes it a perfect fit for advanced automotive applications as well as in industrial and consumer applications.



Features

Following features are supported by the KP235:

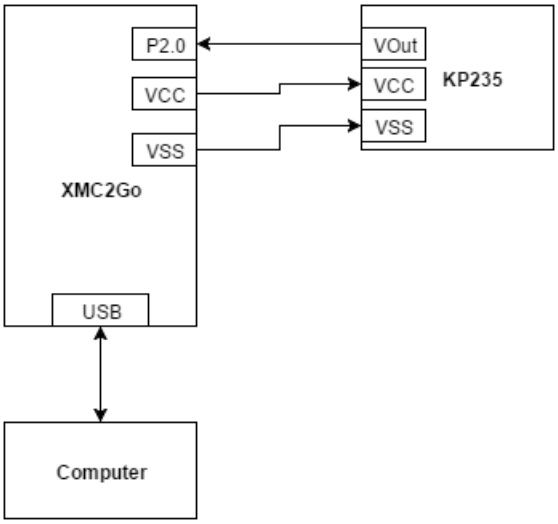
- High precision pressure sensing (± 1.2 kPa)
- Ratiometric analog output
- Large temperature range (-40 °C to 125 °C)
- Broken wire detection • “Green” 8 pin SMD housing
- Automotive qualified

Target Applications

The KP235 is defined for use in following target applications:

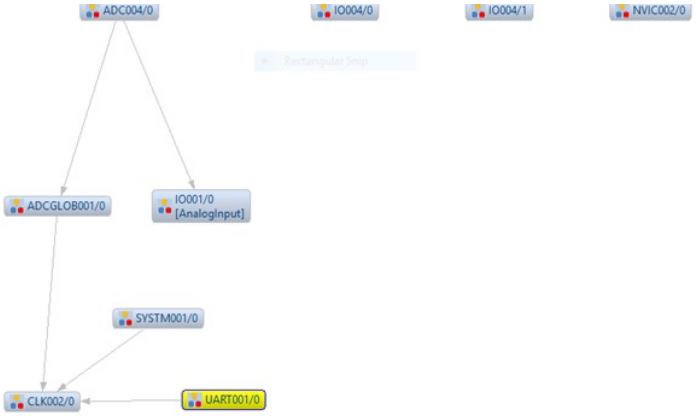
- Automotive applications (barometric air pressure measurement)
- Industrial control
- Consumer applications
- Medical applications
- Weather stations
- Altimeters

Architecture Diagram:



6. Software

DAVE components used:



To compute the pressure from output voltage it must be used the transfer function from datasheet:

$$V_{OUT} = V_{DD} \times (a \times P + b)$$

From this equation P can be determined based on Vout and a, b constants.

```
#include <DAVE3.h
/* To store the conversion result */
ADC004_ResultHandleType Result;
```

```
uint32_t ledTime = 100;
handle_t timerHandle;
uint32_t delay;
double pressure; //[kPa]
#define a 0.01067
#define b -0.32667

void ledTimerCallback()
{
 delay++;
}
void adcCallback()
{
 ADC004_GetResult(&ADC004_Handle0, &Result);
 double vOut = Result.Result * 0.00122;
 pressure = ( ( vOut / 5 ) - b ) / a;
 char pres[11];
 sprintf( pres, "%.2f kPa\n", pressure );
 for(int i = 0; i < 11; i++)
 {
    UART001_WriteDataBytes( &UART001_Handle0, (uint8_t *)&pres[i], 1
);
    for(int j = 0; j < 1000; j++);
 }
 if(Result.Result != 0)
 {
    ledTime = (4095 - Result.Result) / 20;
 }
}
int main(void)
{
 DAVE_Init();              // Initialization of DAVE Apps
 /* Generate Load Event*/
 timerHandle = SYSTM001_CreateTimer(100, SYSTM001_PERIODIC,
adcCallback, 0);
 SYSTM001_StartTimer(timerHandle);
```

```
 timerHandle = SYSTM001_CreateTimer(10, SYSTM001_PERIODIC,
ledTimerCallback, 0);
 SYSTM001_StartTimer(timerHandle);
 ADC004_GenerateLoadEvent(&ADC004_Handle0);
 while(1)
 {
    if(ledTime < delay)
    {
       IO004_TogglePin(IO004_Handle0);
       IO004_TogglePin(IO004_Handle1);
       delay = 0;
    }
 }
 return 0;
}
```

7. Project results & applications

After testing the output of sensor I have the following results:

The normal pressure of the air is 89.5 kPa.
I managed to increase the pressure in a plastic bag to 93.5 kPa

8. Reference

http://www.infineon.com/dgdl/Infineon-KP235-DS-v01_00-en.pdf?fileId=db3a30432ad629a6012af67ba47c0b0f

http://www.infineon.com/cms/en/product/evaluation-boards/KIT_XMC_2GO_XMC1100_V1/productType.html?productType=db3a304443537c4e01436ccecb5d154f