PSoC® 1 – Interfacing a Pressure Sensor – MPXM2102A

Project Name: Example_Pressure_Sensor
Programming Language: C
Associated Part Families: CY8C29/27/24/22
Software Version: PSoC® Designer™ 5.2
Related Hardware: CY3210 – PSoC Eval1 Board
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Objective

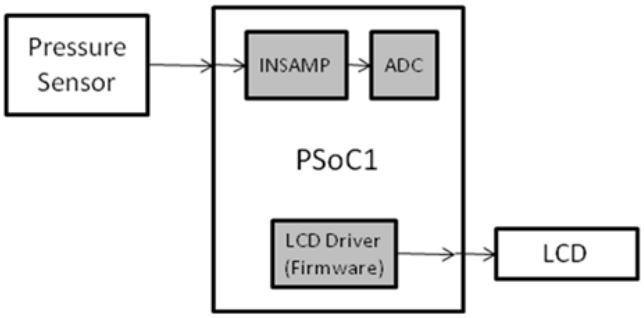
This project illustrates the interface between PSoC® and a pressure sensor (MPXM2102A) and displays the pressure level on the LCD.

Overview

The MPXM2102A pressure sensor provides the differential analog voltage corresponding to the pressure applied. This value is amplified by the Instrumentation Amplifier and is then measured by ADCINCVR UM to calculate the pressure level, ranging from 0 kPa to 100 kPa, to display it on the LCD.

Note MPXM2102A is used for example purpose only. Any analog pressure sensor can be integrated with PSoC subject to operating specifications.

Block Diagram



User Module List and Placement

The following table lists user modules used in this code example and the hardware resources occupied by each user module.

User Module	Placement
INSAMP	ACB00, ACB01, ASD11
ADCINCVR	ASC10, DBB00, DBB01, DCB02
LCD	Software Implementation

User Module Parameter Settings

The following tables show the user module parameter settings for each of the user modules used in the code example.

INSAMP		
Parameter	**Value**	**Comments**
Analog bus	Disable	Will NOT route the output of the INSAMP onto the analog bus.
Common mode out	No Connect	Do not connect the common mode output.
Differential gain	48.00	Set the differential gain to 48.
Conversion gain	1.00	Set the conversion gain provided by SCBLOCK to 1.
ADCINCVR		
Parameter	**Value**	**Comments**
Input	ASD11	Select the output block of the INSAMP as the input of ADCINCVR.
Clock phase	Swap	See notes below
Clock	VC1	Selects the input clock of the ADCINCVR as the VC1.
ADC resolution	13	Sets the resolution of the ADC to 13 bits.
Calc time	8	See notes below
Data format	Unsigned	Output will vary from 0 to 2^ADC Resolution – 1.

Notes

- The parameter 'Clock Phase' should be opposite to the SCBLOCK clock phase, which is sourcing the data. In the default configuration of INSAMP, SCBLOCK uses the clock phase as 'Normal'. Thus, it should be set to 'Swap' in the ADC. If it is fed from a Continuous Time Block then it should be set to 'Normal'.
- CalcTime is calculated using the Data Clock and the resolution of the ADC. Refer to the User Module data sheet for the formula and calculations involved.

LCD		
Parameter	**Value**	**Comments**
LCDPort	Port 2	Use Port 2 for connecting LCD
Bargraph	Disable	Disable the Bar graph feature

Global Resources

Important Global Resources		
Parameter	**Value**	**Comments**
Power setting [V_{CC} / SysClk freq]	5.0 V/24 MHz	Selects 5 V operation and 24 MHz SysClk
CPU_Clock	SysClk/2	Selects 12 MHz as the clock input for the CPU
VC1 = SysClk/N	8	Set VC1 as 3 MHz.
Ref Mux	(V_{DD}/2) +/- V_{DD}/2	Set the RefHi as 5 V and RefLo as 0 V.

Pinouts

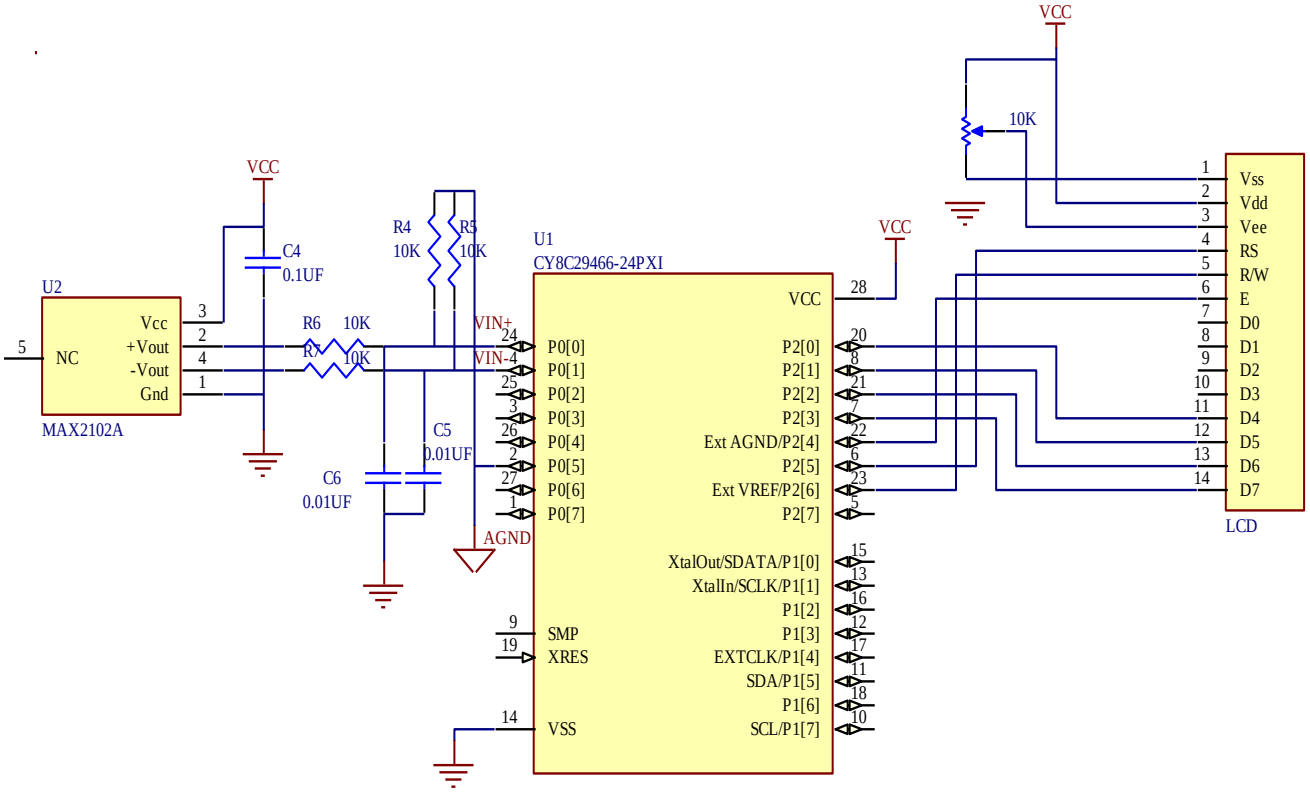
Important Pin Configuration				
Pin	**Select**	**Drive**	**Interrupt**	**Comments**
P0[0]	Analog input	High Z Analog	DisableInt	Configures the pin as analog input pin and connects it to V_{IN}+ of the sensor.
P0[1]	Analog input	High Z Analog	DisableInt	Configures the pin as analog input pin and connects it to V_{IN}- of the sensor.
P0[5]	AnalogOutBuf_1	High Z Analog	DisableInt	Routes the AGND at P0[5]

Note

Other parameters may be left at their default values.

Hardware Connections

The schematic diagram for this code example is as follows.



U2 is MPXM2102A which is a silicon piezoresistive pressure sensor providing linear voltage output. This is directly proportional to the applied pressure. It measures the pressure applied with respect to built-in reference vacuum and provides a differential analog signal. This device is ratiometric within the specified excitation range. It means that the sensitivity of the device is proportional to the excitation voltage applied. It is capable of measuring pressure ranging from 0 kPa to 100 kPa with a change of 0.2 mV/kPa.

Because of limited ADC resolution, the signal is first amplified using an Instrumentation Amplifier which introduces the offset. To remove this offset Correlated Double Sampling (CDS) is used. For more details on CDS, refer to the application note AN2226.

This schematic can be wired using the bread board area of the CY3210 PSoC Eval1 board.

The LCD module should be placed on J9 on the board.

Note: The PSoC's Internal AGND is routed to P0[5].

Operation

On reset, all hardware settings from the device configuration are loaded into the device and *main.c* is executed.

The firmware performs the following operations:

- Global interrupt is enabled.
- All the modules are initialized with maximum power setting.
- ADCINCVR is initialized to run continuously.
- An infinite loop is entered where the following operations are performed:
  - Connect the input of the instrumentation amplifier to the sensor output.
  - Drop a few samples and measure the input signal.
  - Connect the input of the instrumentation amplifier to the AGND pin (P0[5]).
  - Drop a few samples and measure the offset.
  - Calculate the signal value by subtracting the offset if the signal value is greater than offset.
  - Calculate the Analog Voltage level by multiplying the calculated signal by 1.22 (resolution of ADCINC12 in mV).
  - Convert the analog signal obtained by the previous step into kPa by dividing it with the sensitivity of the sensor.
  - Convert this float value into the ASCII value using the ‘ftoa’ function.
  - Update the LCD with the new value.

Note

This code example is just to illustrate the interface between the PSoC® and a Pressure Sensor (MPXM2102A) and is not tested for *accuracy* as it requires testing in a pressure chamber for calibration. The tests were performed on the basis of analog output of the Pressure Sensor.

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