PSoC® 1 – Interfacing a Relative Humidity Sensor HIH-4031

Project Name: Example_Humidity_Sensor
Programming Language: C
Associated Part Families: CY8C29/28/27/24/22xxx
Software Version: PSoC® Designer™ 5.2
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Related Hardware: CY3210 – PSoC Eval1 Kit

Objective

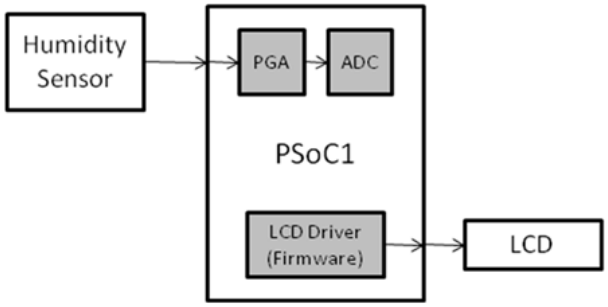
This project demonstrates how to interface PSoC® to an analog output relative humidity sensor HIH-4031 and display the humidity level on the LCD.

Overview

The HIH-4031 humidity sensor provides the analog voltage corresponding to the humidity level. This voltage is fed to the ADCINC12 user module through PSoC internal programmable gain amplifier (PGA), which is configured as a buffer. The relative humidity (RH) value is calculated in percentage and is displayed on the LCD.

Note HIH-4031 is used for example purpose only. Any analog humidity sensors 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 project and the hardware resources occupied by each user module.

User Module	Placement
PGA	ACB01
ADCINC12	ASD11, DBB00, DBB01
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 project.

PGA		
Parameter	**Value**	**Comments**
Gain	1.00	To make the PGA as a unity gain amplifier.
Input	AnalogColumn_InputSelect_1	Selects the output of analog column input multiplexer as the input
Reference	V_{SS}	Use the V_{SS} of the IC as the reference.
Analog Bus	Disable	Does not route the output of the PGA to the analog bus.

ADCINC12		
Parameter	**Value**	**Comments**
TMR Clock	VC1	See following notes.
CNT Clock	VC1	See following notes.
Input	ACB01	Selects the input as the output of the ACB01 block that is PGA configured as a Unity Gain Amplifier.
Clock Phase	Normal	See following notes.

Notes

- Timer clock and CNT clock should be the same for correct operation of the user module. This is also called data clock. It should not be set less than 256 KHz when CPU is running at 24 MHz; or it may be set as low as 125 KHz.
- The parameter Clock Phase should be set to Normal when the data fed to the user module is from a Continuous Time Block. If it is fed from a Switched Capacitor Block, then it must be the opposite of the clock phase setting of the SCBLOCK, which sources the data to this user module.

LCD		
Parameter	**Value**	**Comments**
LCDPort	Port 2	Use Port 2 to connect the LCD
Bargraph	Disable	Disable the bar graph feature

Global Resources

Important Global Resources		
Parameter	**Value**	**Comments**
Power Setting [Vcc/SysCl freq]	5.0 Vk/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

Note When RH sensor is operated at 5 V, the output voltage of the sensor ranges from 0.958 V to 4.026 V. Ref Mux setting should be done accordingly because ADC must cover the entire range.

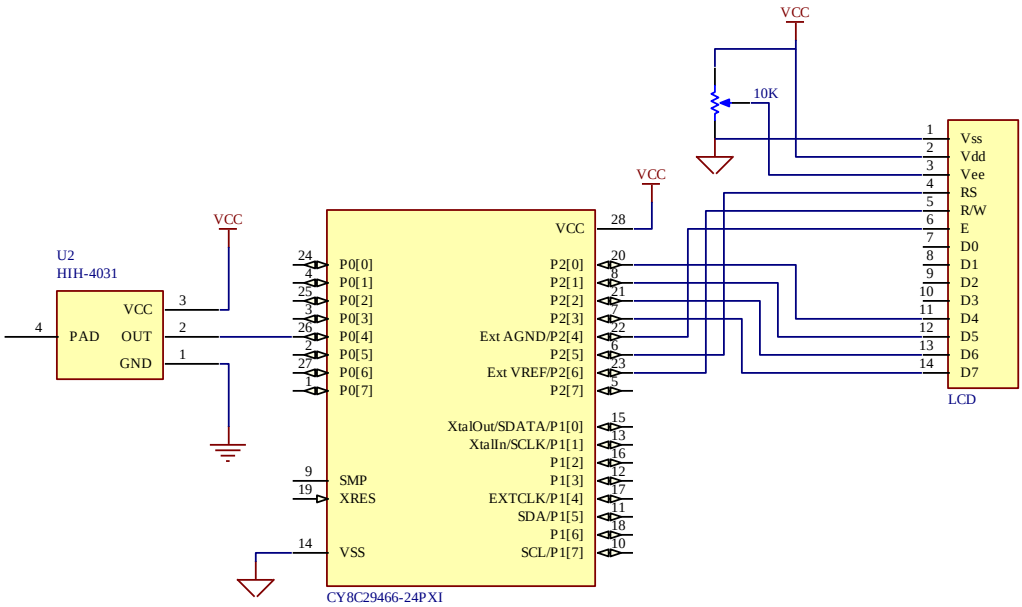
Pinout

Important Pin Configuration				
Pin	**Select**	**Drive**	**Interrupt**	**Comments**
P0[4]	Analog Input	High-Z Analog	DisableInt	Configures the pin as analog input pin.

Note Other parameters are left at their default values.

Hardware Connections

The schematic diagram for the project is as follows.



U2 is HIH-4031 is a relative humidity sensor which is capable of measuring humidity ranging from 0% RH to 100% RH. This device exhibits a linear output versus percentage RH. Percentage RH value can be calculated using the following formula:

%RH = (V_{OUT} – Zero Offset)/slope

When operated at 5 V, Zero Offset = 0.958 V and slope = 30.68 mV.

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

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:

- Enables global interrupt.
- Initializes all the modules with maximum power setting.
- Initializes ADCINC12 to run continuously.
- Enters an infinite loop where the following operations are performed:
  - Wait until ADCINC12 data is available.
  - Convert the 2s compliment data into unsigned format by adding 0x800.
  - Calculate the analog voltage level by multiplying the output of ADC by 1.22 (resolution of ADCINC12 in mV).
  - Check if analog value is greater than zero offset.
  - If voltage level is greater than zero offset:
    - Calculate the % RH using equation 1.
    - Convert this float value into ASCII value using FTOA function.
    - Update the LCD with the new value.
  - If voltage level is lesser than zero offset:
    - Update the LCD with RH value as 0.00%.

Testing

Program the PSoC device with this project and connect the hardware according to the schematic shown above and the relative humidity can be viewed on the LCD.

Upgrade information

N/A

Note This project is just to illustrate the interface between the PSoC® and a Humidity sensor (HIH-4031) and is not tested for *accuracy* as it requires a controlled environment. The tests were performed on the basis of analog output of the Humidity Sensor.

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