CE95277 - Delta Sigma ADC in single-ended mode with PSoC 3/5LP

Objective

This code example demonstrates how to use the DelSig ADC to take samples of an analog input and send those samples to a PC application over RS-232 via the UART component.

Overview

This code example implements a simple data collection system using the DelSig ADC and the UART component. The ADC continuously samples an analog input. The resulting samples can be sent to a PC over a UART connection a single sample at a time or continuously. Emulated data, which is just an incrementing number, can also be sent over the UART connection to test the communication. The USB UART in the KitProg is used to create an RS-232 connection to a terminal program on a PC. The terminal program is used to send commands to get the ADC sample data and read the resulting responses.

PSoC Resources

Cypress provides a wealth of data at www.cypress.com to help you to select the right PSoC device for your design, and quickly and effectively integrate the device into your design. For a comprehensive list of resources, see KBA86521, How to Design with PSoC 3, PSoC 4, and PSoC 5LP. The following is an abbreviated list for PSoC 3 and PSoC 5LP:

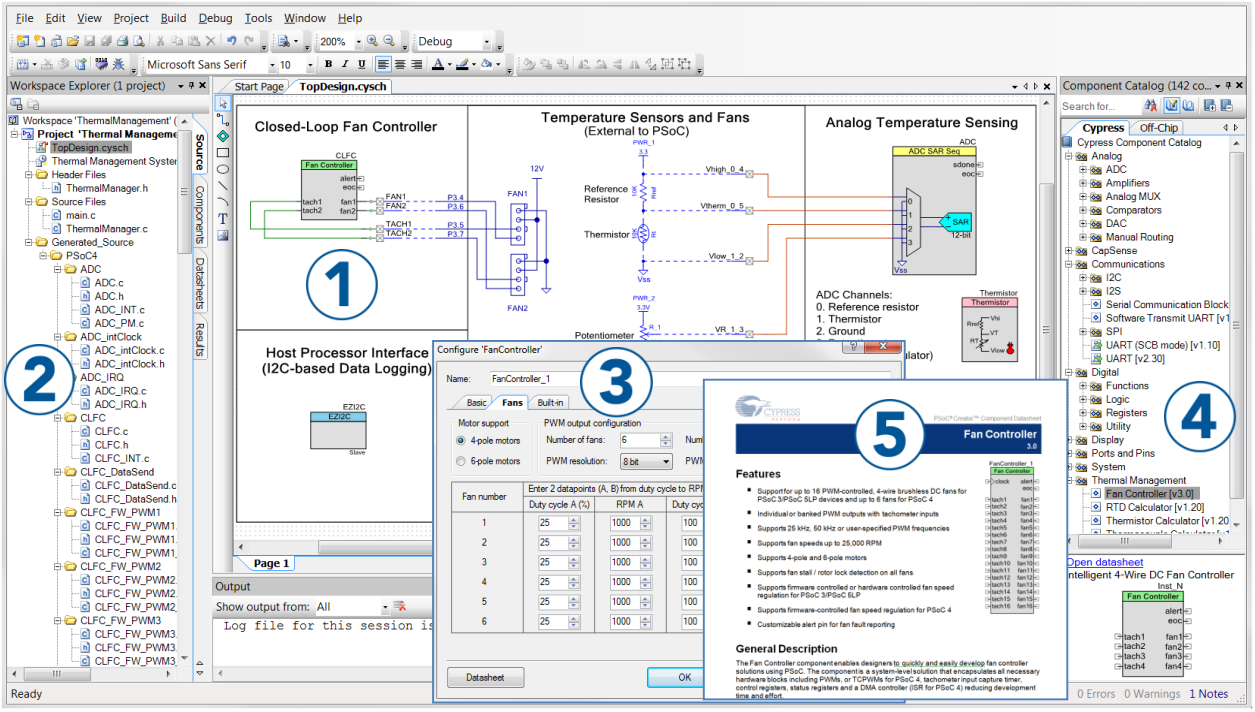
- **Overview:** PSoC Portfolio, PSoC Roadmap
- **Product Selectors:** PSoC 1, PSoC 3, PSoC 4, or PSoC 5LP. In addition, PSoC Creator includes a device selection tool.
- **Datasheets**: Describe and provide electrical specifications for the PSoC 5LP device families
- **CapSense Design Guide:** Learn how to design capacitive touch-sensing applications with the PSoC 5LP family of devices.
- **Application Notes and Code Examples:** Cover a broad range of topics, from basic to advanced level. Many of the application notes include code examples.
- **Technical Reference Manuals (TRM):** Provide detailed descriptions of the architecture and registers in each PSoC 5LP device family.
- **Development Kits:**
  - CY8CKIT-001 is a common development platform for all PSoC family devices.
  - CY8CKIT-050 is a development platform targeted at analog intensive designs for PSoC 5LP.
  - CY8CKIT-030 is a development platform targeted at analog intensive designs for PSoC 3.
  - CY8CKIT-059 is a rapid prototyping kit for PSoC 5LP.
- The MiniProg3 device provides an interface for flash programming and debug.

PSoC Creator

PSoC Creator is a free Windows-based Integrated Design Environment (IDE). It enables concurrent hardware and firmware design of systems based on PSoC 3, PSoC 4, and PSoC 5LP. See Figure 1 – with PSoC Creator, you can:

1. Drag and drop Components to build your hardware system design in the main design workspace
2. Codesign your application firmware with the PSoC hardware
3. Configure Components using configuration tools
4. Explore the library of 100+ Components
5. Review Component datasheets

Figure 1. PSoC Creator Features



Requirements

Tool: PSoC Creator 3.1 SP2 or later

Programming Language: C (GCC 4.8.4 or later)

Associated Parts: PSoC 3 and PSoC 5LP parts

Related Hardware: CY8CKIT-059, CY8CKIT-001, CY8CKIT-050, CY8CKIT-030

Design

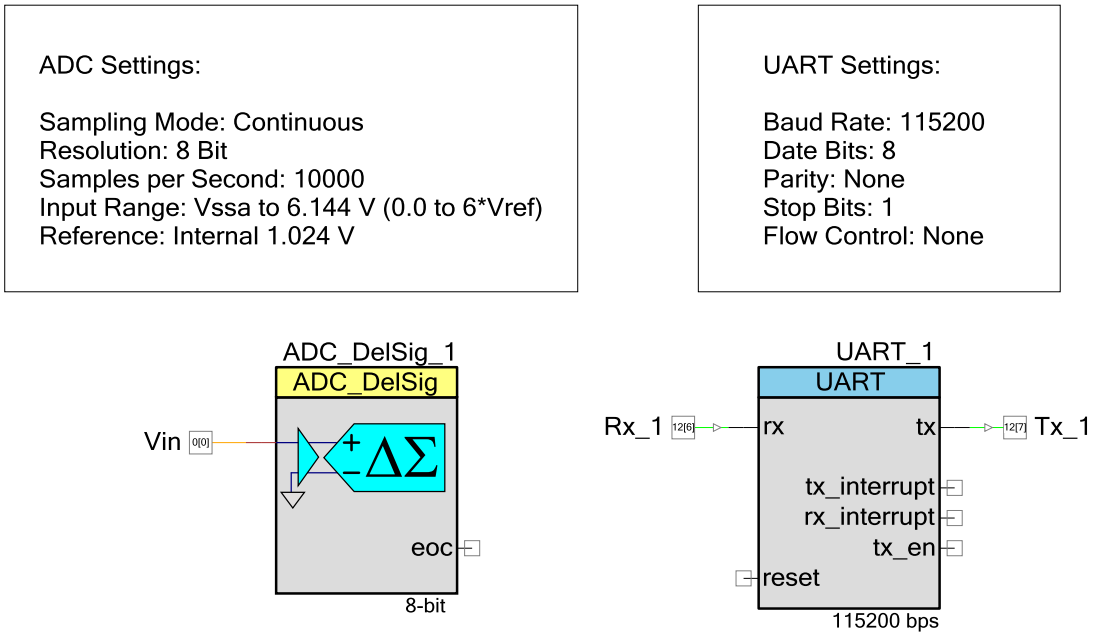


Figure 2 Code Example Creator Schematic

The code example uses the DelSig component to sample the analog input and the UART component to transmit the sampled data to the PC over RS-232.

All of the firmware for the code example is implemented in main.c. The firmware performs the following functions:

1. Starts the ADC and UART components.
2. Checks for ADC end of conversion. Stores latest result if conversion complete.
3. Checks for UART input.
    - 'C' or 'c' received: transmits the last sample via the UART.
    - 'S' or 's' received: continuously transmits samples as they are completed.
    - 'X' or 'x' received: stops continuously transmitting samples.
    - 'E' or 'e' received: transmits a dummy byte of data.

Hardware Setup

Connect a voltage source to P0[0] on the kit. If P0[0] is not available you can change the Vin pin in the design wide resources file (CE95277 ADC and UART.cywdr, Pins tab). If a voltage source is not available you can test the UART connection using the emulated data by sending ‘e’ or ‘E’ over the terminal connection.

This code example is targeted towards the CY8CKIT-059. If using this kit, then no external hardware connections are needed to allow UART communication. If using a different hardware platform you may need to connect the UART Tx (P12[7]) and Rx (P12[6]) to an RS-232 interface.

If you are not using the CY8CKIT-059 then you may also need to target a different PSoC device. To do so, right click the project in the Workspace Explorer and select Device Selector. Select the appropriate PSoC device for your hardware platform.

Software Setup

To interface with the UART on the PSoC device a terminal emulator application is needed. Hyperterm and Putty are examples of valid options. Open up a connection to the COM port number that the PC gives to the PSoC device when it enumerates. Make sure the settings in the software COM port match the settings for the UART component, detailed in the Parameter Settings section below.

Components

Table 1 lists the PSoC Creator Components used in this example, as well as the hardware resources used by each.

Table 1. List of PSoC Creator Components

Component or User Module	Hardware Resources
DelSig ADC	DelSig ADC
Full UART	UDBs (3 Datapath Cells, 58 macrocells, 2 Status Cells, 2 Control Cells, 2 interrupts)
Analog Pin (Vin)	P0[0]
Digital Input Pin (Rx_1)	P12[6]
Digital Output Pin (Tx_1)	P12[7]

Parameter Settings

Component	Non-default Parameter Settings
DelSig ADC	Sampling Mode: Continuous Resolution: 8 Bit Samples per Second: 10000 Input Range: Vssa to 6.144 V (0.0 to 6*Vref) Reference: Internal 1.024 V
UART	Baud Rate: 115200 Date Bits: 8 Parity: None Stop Bits: 1 Flow Control: None
Analog Pin (Vin)	High Impedance Analog
Digital Input Pin (Rx_1)	High Impedance Digital, Hardware Connection
Digital Output Pin (Tx_1)	Strong Drive, Hardware Connection

Design-Wide Resources

Figure 3 shows the pin selections for the code example.

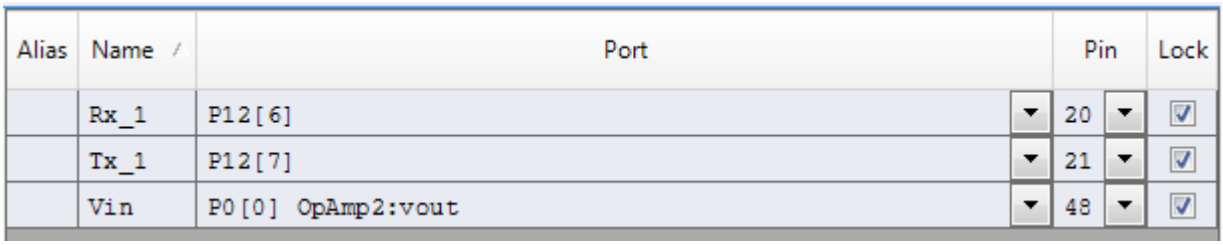


Figure 3 Pin Selection

Operation

1. Connect the board to the PC using the USB connector of the KitProg. On the CY8CKIT-059 this is the PCB-USB connector.
2. Program the example project to the board.
3. Connect an external voltage to the PSoC 5LP target device on P0[0]
4. Open a terminal emulator on the PC and connect to the virtual COM port, enumerated as a part of KitProg
5. Type character “C” or “c” in the terminal emulator to receive one sample of ADC data.
6. Type character “S” or “s” in the terminal emulator to receive continuous samples of ADC data.
7. Type character “X” or “x” in the terminal emulator to stop receiving ADC samples.
8. Type character “E” or “e” in the terminal emulator to receive one emulated sample of data. This data will increment by 1 each time an emulated sample is requested.

Upgrade Information

N/A

Related Documents

Table 2 lists all relevant application notes, code examples, knowledge base articles, device datasheets, and Component datasheets.

Table 2. Related Documents

Application Notes		
AN84783	Accurate Measurement Using PSoC® 3 and PSoC 5LP Delta-Sigma ADCs	Shows how to increase accuracy of DelSig measurements.
AN61102	PSoC® 3 and PSoC 5LP - ADC Data Buffering Using DMA	Shows how to buffer data from the DelSig using DMA.
AN58304	PSoC® 3 and PSoC 5LP – Pin Selection for Analog Designs	Provides an overview of analog routing in PSoC 3/5LP and recommendations for pin selection.
AN58827	PSoC® 3 and PSoC 5LP Internal Analog Routing Considerations	Shows how to choose the best routes for analog sensitive designs.
AN68403	PSoC® 3 and PSoC 5LP Analog Signal Chain Calibration	Shows how to calibrate the analog signal chain in PSoC 3/5LP.
Code Examples		
CE95271	Delta Sigma ADC in Differential Mode with PSoC 3/5LP	
CE95273	Delta Sigma ADC in single-ended mode using DMA and VDAC with PSoC 3/5LP	
CE95299	Delta Sigma ADC using 16 multiplexed single-ended inputs with PSoC 3/5LP	
CE95302	Delta Sigma ADC and I2C Slave with PSoC 3/5LP	
CE95388	UART Receive with PSoC 3/4/5LP	
CE95389	UART Transmit with PSoC 3/4/5LP	
PSoC Creator Component Datasheets		
ADC DelSig		Details the use of the DelSig component.
UART		Details use of the UART component
Device Documentation		
PSoC 3 Datasheets	PSoC 3 Technical Reference Manuals	
PSoC 4 Datasheets	PSoC 4 Technical Reference Manuals	
PSoC 5LP Datasheets	PSoC 5LP Technical Reference Manuals	
Development Kit (DVK) Documentation		
PSoC 3 and PSoC 5LP Kits		
PSoC 4 Kits		

Document History

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Revision	ECN	Orig. of Change	Submission Date	Description of Change
**		KLMZ		New spec

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