

# DelSig\_I2CS Example Project

## 1.0

## Features

- 8-channel sequenced Delta Sigma ADC
- I2C Slave
- Easy debugging using Character LCD
- Exception Handling

## General Description

This example project is also a PSoC Creator starter design. This design shows a 16-bit differential ADC, hardware multiplexed into 8 channels, and transported over I2C. To test this design, an I2C Slave project (DelSig\_I2CS\_Test) is available as a separate example project.

This starter design also includes advanced debugging techniques to detect and handle system level faults and conditions, such as a missing wire or missing device on the bus. The PSoC 0.1% internal voltage reference shows the additional BOM integration.

This design makes it easy to get started and utilize precision analog capability of PSoC.

## Development kit configuration

The following configuration instructions provide a guideline to test this design with the DelSig\_I2CM\_Test Example Project. For simplicity, the instructions describe the stepwise process to be followed when testing this design with 2 PSoC Development Kits (CY8CKIT-001), but can be generalized for the PSoC 3 Development Kit (CY8CKIT-030) and PSoC 5 Development Kit (CY8CKIT-050) as well.

1. Set LCD power jumper J12 to ON position and position jumpers for Vdd, Vdda and Vddd to be at 5V for both the main and test board.
2. In order to generate different voltages to test the Example Project, set up a resistor ladder on the breadboard available on the CY8CKIT-001 (See Figure 2). Use 7 resistors of 10k ohm in series, followed by a 0 ohm resistor or jumper wire to ground. Starting from the top of the first 10k resistor tap each point of the resistor ladder to P0[0] to P0[6]. The zero-ohm resistor tap is sent to P1[4], and P2[7] is also connected to ground. Finally, connect the current output of the IDAC – from P0[7] to the top of the resistor ladder – P0[0].
3. For the I2C communication, connect P12[0] to SCL, P12[1] to SDA. Use 2 external 2.67k resistors to pull-up SCL and SDA to 5V (Figure 1). Note that Figure 1 is a depiction for the

purpose of understanding the external connections and not the actual PSoC Creator schematic (Figure 2).

4. Externally connect the corresponding pins (SCL and SDA) on I2C Slave board to the master test board as depicted in Figure 1.

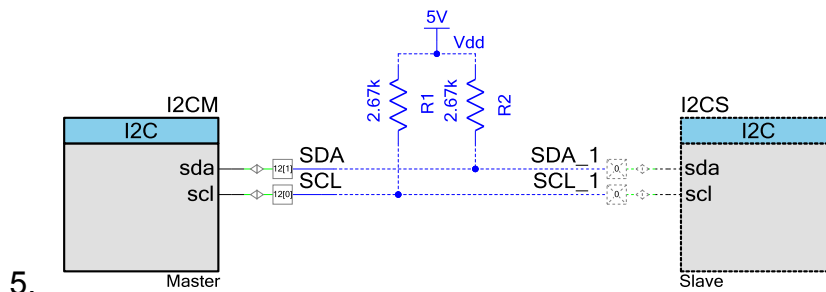


Figure 1. Connection of SDA and SCL to pull-up resistors

6. Connect the Character LCD to P2[6:0] on both boards.
7. Ensure that the grounds of the two boards are tied together.
8. Build the DeISig\_I2CS project and then program the hex file onto the main board, and repeat this for the DeISig\_I2CS\_Test project and its corresponding board. After programming is complete, disconnect the MiniProg3.
9. Power cycle the master device and reset the slave device.

## Project configuration

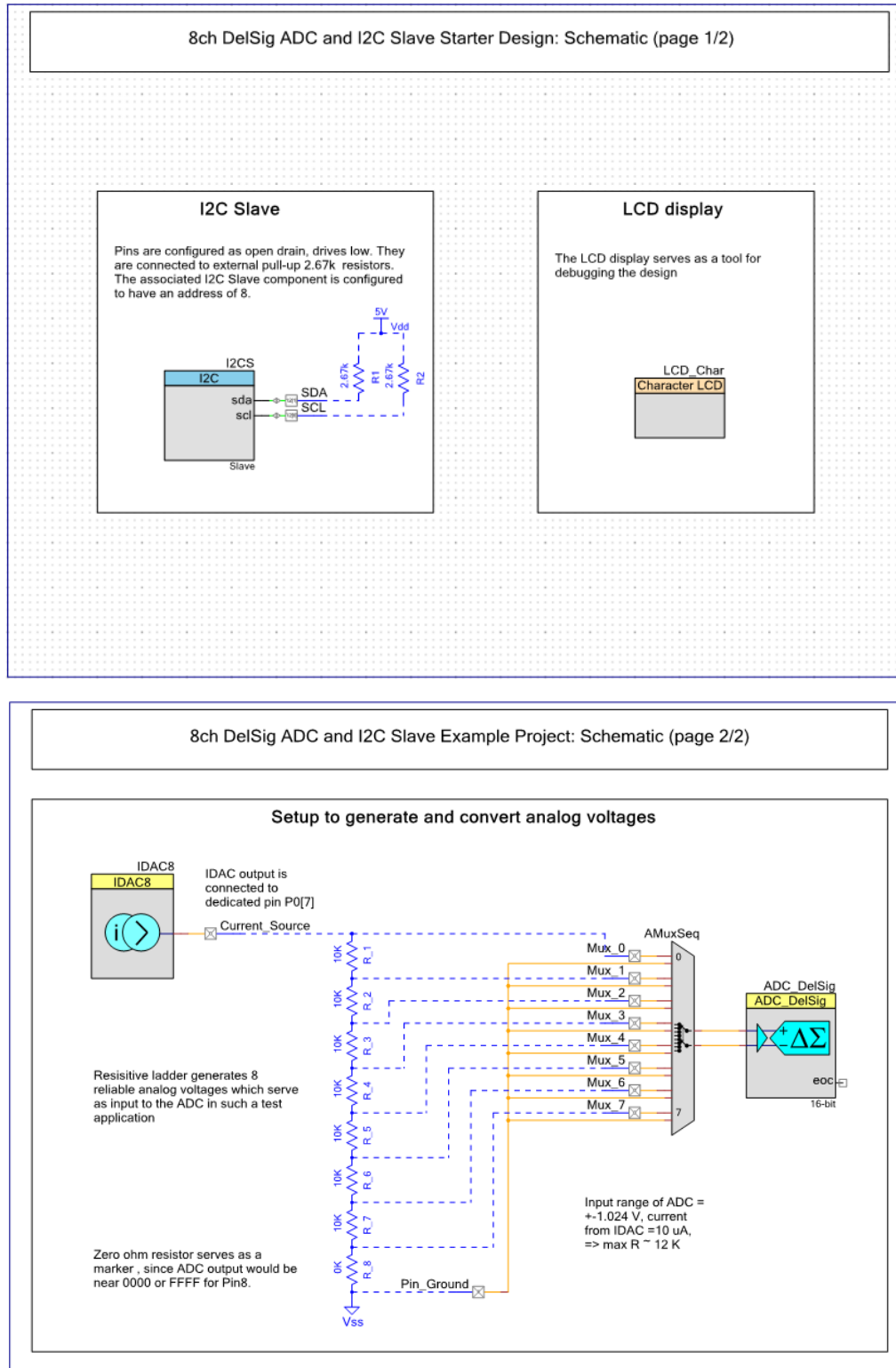
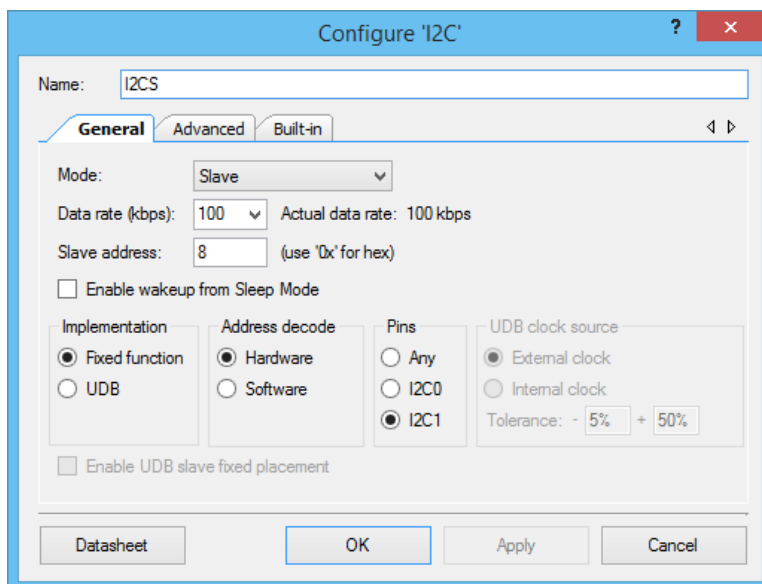


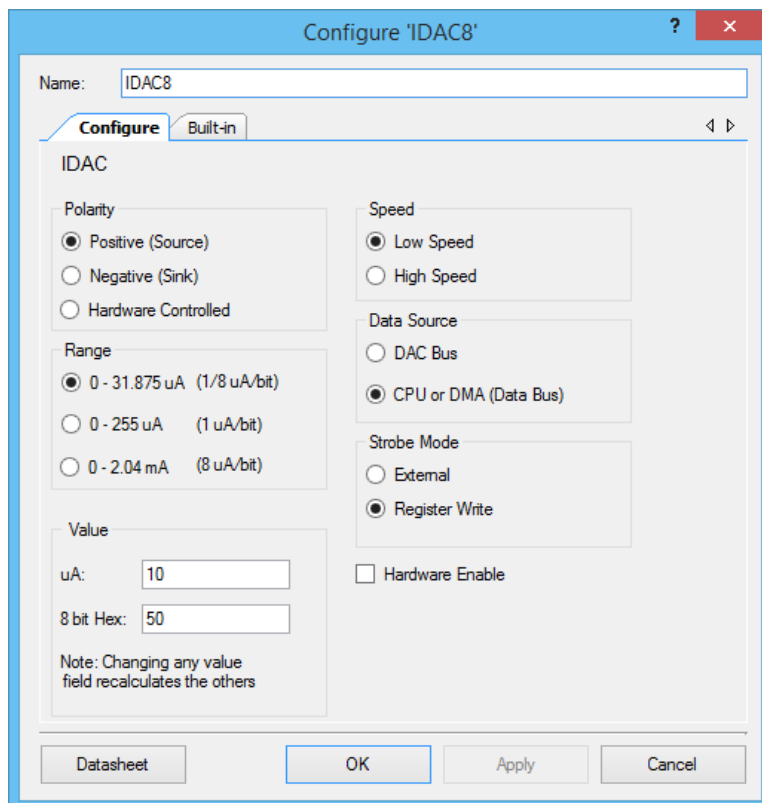
Figure 2. I2C Slave Top design schematic

The top design schematic is shown in Figure 2 above. As shown in Figure 3, a Fixed Function I2C block is used, with a data rate of 100 kbps and an address of 8.



The 'Configure I2C' dialog box is shown with the 'General' tab selected. The 'Name' field is 'I2CS'. The 'Mode' is set to 'Slave'. The 'Data rate (kbps)' is '100', with 'Actual data rate: 100 kbps' displayed. The 'Slave address' is '8', with a note '(use '0x' for hex)'. There is an unchecked checkbox for 'Enable wakeup from Sleep Mode'. Under 'Implementation', 'Fixed function' is selected. Under 'Address decode', 'Hardware' is selected. Under 'Pins', 'I2C1' is selected. Under 'UDB clock source', 'External clock' is selected, with a tolerance of '- 5%' to '+ 50%'. There is an unchecked checkbox for 'Enable UDB slave fixed placement'. At the bottom are buttons for 'Datasheet', 'OK', 'Apply', and 'Cancel'.

Figure 3. I2C Slave configuration



The 'Configure IDAC8' dialog box is shown with the 'Configure' tab selected. The 'Name' field is 'IDAC8'. Under 'IDAC', the 'Polarity' is 'Positive (Source)', 'Range' is '0 - 31.875 uA (1/8 uA/bit)', and 'Value' is '10 uA' (with '8 bit Hex: 50'). Under 'Speed', 'Low Speed' is selected. Under 'Data Source', 'CPU or DMA (Data Bus)' is selected. Under 'Strobe Mode', 'Register Write' is selected. There is an unchecked checkbox for 'Hardware Enable'. At the bottom are buttons for 'Datasheet', 'OK', 'Apply', and 'Cancel'. A note at the bottom states: 'Note: Changing any value field recalculates the others'.

Figure 4. IDAC configuration

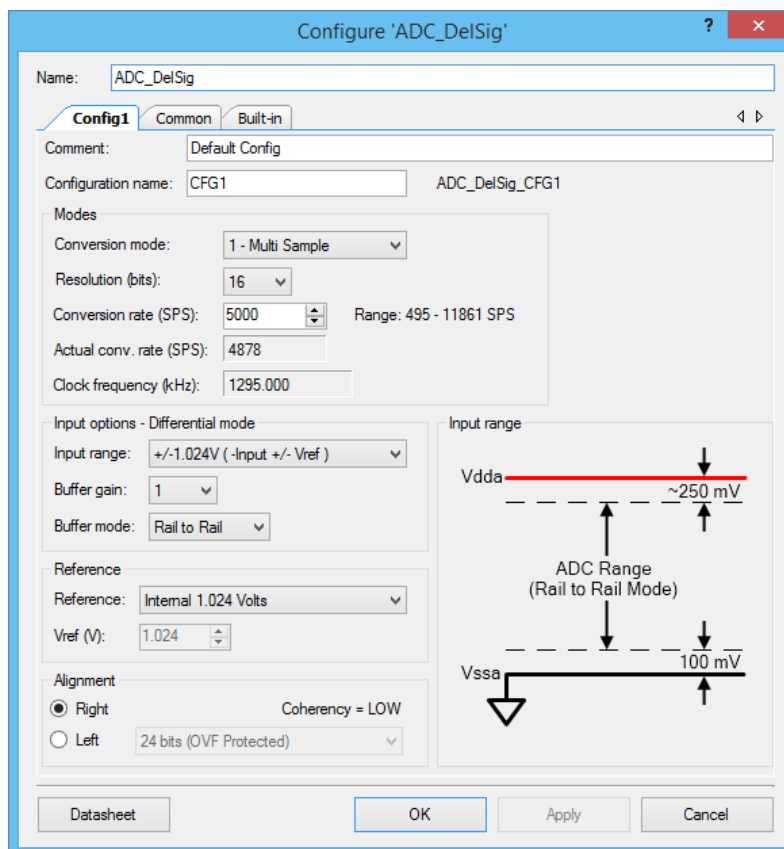


Figure 5. Delta Sigma ADC configuration

The character LCD is left at default settings. The IDAC is set to source current in the 0-31.875  $\mu\text{A}$  range and an initial value of 10 $\mu\text{A}$ . This value can be adjusted according to the input range of the ADC and the value of the resistors in the resistor ladder.

The analog sequencing mux is configured for 8 differential inputs, and all the analog pins are used with their default settings. Figure 5 shows the configuration for the Delta Sigma ADC. The test project has a very simple setup as shown in Figure 6 and Figure 7.

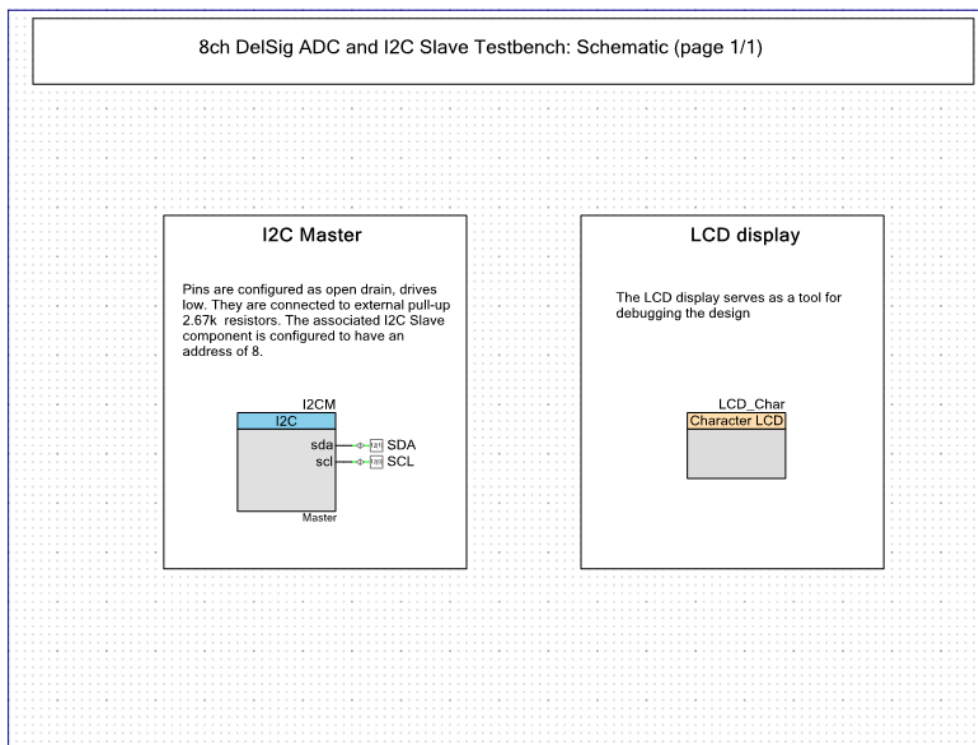


Figure 6. I2C Master Top design schematic

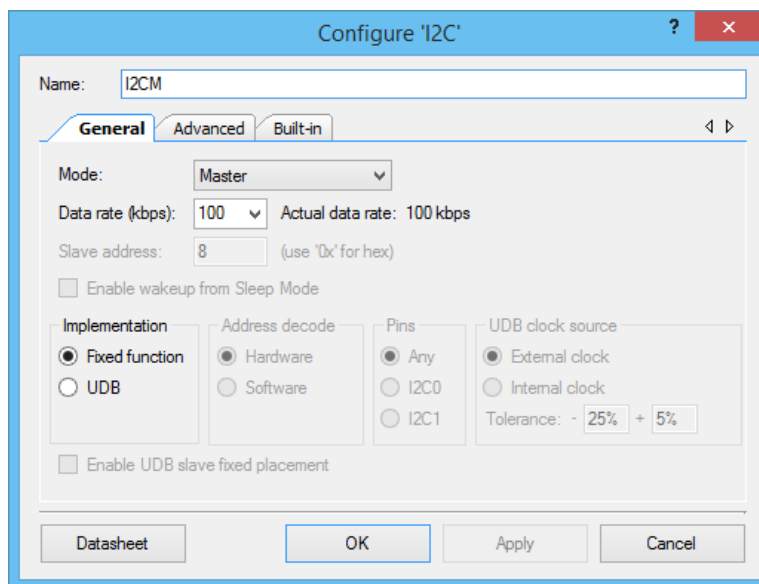


Figure 7. I2C Master configuration

## Project description

The analog voltages input to the analog sequencing mux, are selected in succession. Each selected analog voltage is converted by the ADC, and stored in a read buffer. This read buffer is read by the Master in the test project every 2 seconds (to facilitate reading of the LCD). Subsequent channels are selected and read every time the I2C master reads the I2C slave data buffer. The digital value out of the ADC is also displayed on the Character LCD on the development kit.

The receiver board has a pre-configured I2C master which reads new data from the I2C slave. When new data is read, this is displayed using the Character LCD. After a delay of 2 seconds the I2C master again starts checking for new data from the I2C slave. The functionality is verified by checking the data displayed on the main and test board LCDs (at the same time).

## Expected Results

The Character LCD on the master board as well as the slave board should display the same hexadecimal representation of the analog inputs fed from the resistor ladder. The subsequent analog voltage values should appear every 2 seconds, while cycling through all 8 voltages continuously.

## Related Material

### Example Projects

- ADC\_16Channel
- DeISig\_I2CM
- DeISig\_SPIM
- SAR\_SPIM\_USB
- ADC\_DMA\_VDAC

### Component Datasheets

- [Delta Sigma Analog to Digital Converter \(ADC\\_DeISig\) 2.20](#)



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