Using the PSoC® Invention Board

AN2162

Author: Andrew Page
Associated Project: Yes
Associated Part Family: CY8C27xxx
GET FREE SAMPLES HERE
Software Version: PSoC Designer™ Version 4.0 or Higher
PSoC Invention Board Programmer: 1.0
Associated Application Notes: AN2014, AN2026, AN2026a

Note The Invention board was part of a design contest and is no longer offered for sale. The PsoCEval1 board is a versatile, low cost development board that is currently offered.

Application Note Abstract

This application note discusses the PSoC Invention Board included with the Mini Development Kit that was distributed to participants of the 2003 PSoC Design Contest. Details are provided for the PSoC Invention Board hardware and software used to interface with the board. Also included are tips for project design along with an example PSoC project. This application note includes the schematic for the PSoC Invention Board along with answers to Frequently Asked Questions (FAQs).

Introduction

In order to begin using the PSoC Invention Board, the following hardware is necessary:

- PSoC Invention Board.
- USB cable to connect the Invention Board to the PC.
- A PC that meets the minimum system requirements for PSoC Designer v. 4.0 (or newer). The system requirements are located in the PSoC Designer Release Notes. To access the Release Notes in PSoC Designer, select **Help > Documentation**.

The following software is also required for interfacing with the PSoC Invention Board and is found on the CD included with the Mini Development Kit:

- PSoC Designer v. 4.0 or newer.
- PSoC Invention Board Programmer Application.

The CD included with the Mini Development Kit also includes a C Compiler License for PSoC Designer. This C compiler allows the user to write firmware for the PSoC in C.

The trial C Compiler License is only valid for PSoC Designer version 4.0, 4.1, and 4.2. The license is invalid for newer and older versions of PSoC Designer.

Invention Board Hardware

The PSoC Invention Board contains two rows of 14 pins on the bottom side of the PCB. The electrical connections to these pins identically match the pin-out of the CY8C27xxx 28-pin PSoC device.

The only difference between the two rows of connectors and the PSoC pin-out is pin 28 (pin 1 of J2). This pin is labeled VX and is not directly connected to the PSoC's V_{DD} pin 28. For more information regarding the PSoC pin-out, refer to the CY8C27xxx family data sheet, which can be found at http://www.cypress.com under PSoC Mixed-Signal Array.

The pins on the bottom side of the PCB have a standard 0.1" spacing, and the two rows of pins are 0.6" apart. Therefore, it is possible to use a standard 28-pin 0.6" connector to connect the Invention Board to a PCB. Appendix 1 contains the schematic for the PSoC Invention Board.

Figure 1. Top Side of Invention Board PCB

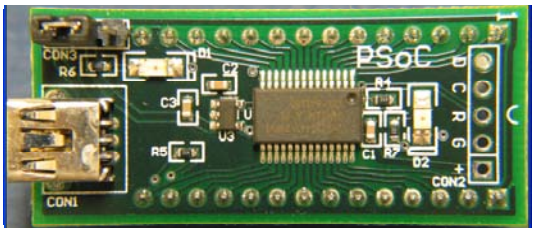


Figure 1 illustrates the top side of the Invention Board PCB. The following is a list of the main components that reside on the top side of the PCB:

- The PSoC resides in the middle of the top side of the PCB. The PSoC CY8C27443-24PVI is the 28-Pin SSOP package.
- Pin 1 of the two rows of 14 pins is marked with a '1'. Since this pin is electrically connected to pin 1 of the PSoC, this pin is P0[7].

- LED D1 indicates if power is being supplied to the PSoC Invention Board.
- LED D2 indicates the presence of USB traffic.
- Connector CON1 is a standard USB mini-B connector.
- Connector CON2 is used for In-System Serial Programming (ISSP). The header is not installed, but the part number for the header is included in Appendix 2. Application Note AN2014 discusses the electrical specifications for the signals used during the ISSP process.

Connector CON3 is used for powering the Invention Board. When a jumper is placed on the two pins closest to the end of the PCB (pins 1 and 2), the Invention Board is powered from the USB bus. When the jumper is placed on the two pins closest to the center of the PCB (pins 2 and 3), the Invention Board is powered from the VX pin on the bottom of the PCB. Always use pins 2 and 3 of CON2 whenever powering the Invention Board with an external source.

Figure 2. Bottom Side of Invention Board PCB

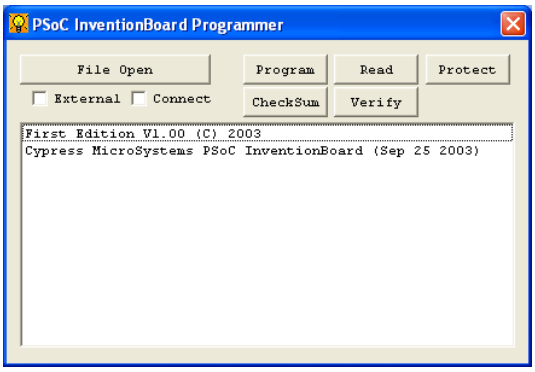
Figure 2 illustrates the bottom side of the Invention Board PCB. The following is a list of the main components that reside on the bottom side of the PCB:

- The USB chip, CY7C64013-SC, provides the USB interface between the PSoC and the PC. It is preprogrammed with the ability to recognize a set of USB commands and convert them into PSoC programming commands via a 2-wire interface.
- X1 is a 6 MHz crystal that clocks the USB chip.

Interfacing Software

The PSoC Invention Board is programmed through a USB interface and the Invention Board Programmer application. Figure 3 is a screenshot of the Invention Board Programmer application user interface.

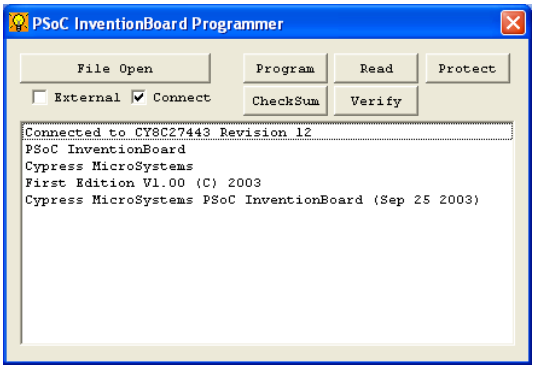
Figure 3. User Interface for Invention Board Programmer



Before programming, the PSoC must be connected to the software application via the USB interface. In order to establish connection, physically connect the USB connector between the USB port on the PC and the Invention Board. Ensure that the jumper on CON3 is placed on pins 1 and 2. Click the **Connect** button on the software application user interface.

The dialogue box displays: “Connected to CY8C27443 Revision 12” as illustrated in Figure 4. The power LED will also be illuminated.

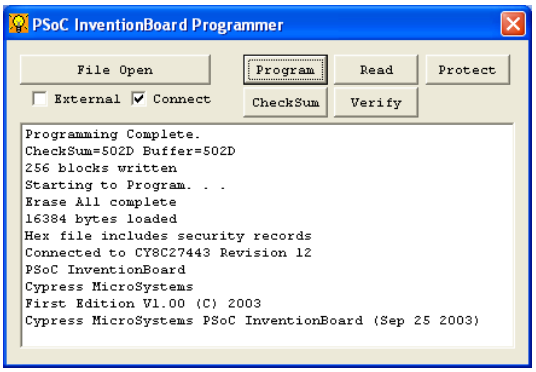
Figure 4. Successful Connection to Invention Board



Next, program the PSoC. To do this, click on the **Program** button. The dialogue box informs you that the part is being programmed. The USB traffic indicator LED illuminates during the programming process.

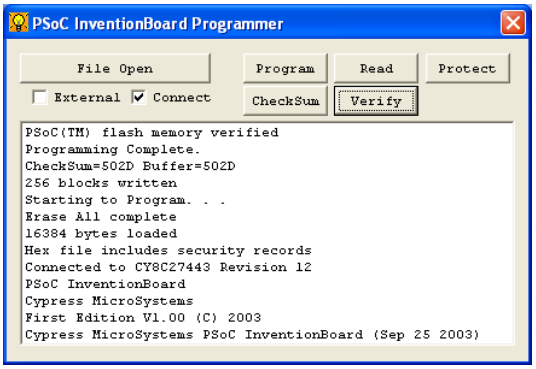
After programming the PSoC, the dialogue box contains information regarding the number of Flash blocks programmed and a checksum of Flash. Also, a message appears letting you know if the programming process was successful. This is illustrated Figure 5.

Figure 5. Programming Process



Finally, verify the programming process by clicking on the **Verify** button. The dialogue box displays a message that states if the Flash was successfully verified as illustrated in Figure 6.

Figure 6. Verification Process



Along with verifying the contents of Flash, the application allows the user to perform a checksum on the Flash, using the CheckSum button. The user also has the capability to read the contents of the Flash by clicking the Read button. Flash can only be read if the protection level allows Flash reads.

An advanced feature of the software application involves the 'Protect' feature. With this feature, the user has the capability of setting the Flash protection for each block without having to program each block.

Invention Board Project Design

The purpose of the Mini Development Kit is to provide users with a tool that allows them to create PSoC projects and program actual PSoC devices with their projects.

The Invention Board is the hardware that allows users to program a PSoC. The Invention Board is not an In-Circuit Emulator (ICE), and therefore the Debugging environment of PSoC Designer cannot be used with the Invention Board. The following outlines the basic steps for designing projects with the Invention Board:

1. Use the Device Editor of PSoC Designer ver. 4.0 to select, place, and set up the desired user modules.
2. Also in Device Editor, set up all global resources and pin configurations.
3. Generate the application in the Device Editor.
4. Use the Application Editor to write the firmware in either assembly or C (with the C compiler code supplied on the Mini Development Kit CD).
5. Build the project in the Application Editor.
6. After successfully building a project, several output files are created. These files are located in the Output folder of the directory where the project is located. The Output folder contains a hex file that is used to program the Invention Board.
7. Use the PSoC Invention Board Programmer application discussed in the previous section to program the PSoC with the hex file obtained in step 6.

Project development with the Invention Board makes excellent use of the PSoC's internal Flash. Since the Invention Board does not support In-Circuit Emulation, the user will more than likely reprogram the PSoC several times in the repetitious cycle of code developing, programming, and testing.

As a general rule of thumb for all code development (but especially with the Invention Board), make it modular. Break the project into several small blocks or modules and test them separately. After the individual modules have been tested to the developer's satisfaction, combine the modules until the project is complete.

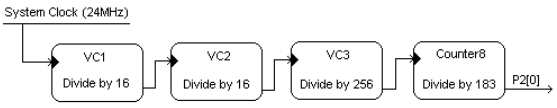
As an example, if one aspect of a user's project is to blink an LED, write and test the portion of code that solely blinks the LED. Test that portion of code with a temporary stimulus, and then apply the actual stimulus intended for the design after adequately testing the LED-blinking firmware with the temporary stimulus.

Example Invention Board Projects

This application note includes an example PSoC project that can be used to verify functionality of the Invention Board. This project is titled LED_Blink. The project utilizes the internal PSoC clock dividers (VC1, VC2, and VC3) and an 8-bit counter to output an approximate 2 Hz-50% duty cycle square wave to P2[0] (Pin 20 of the PSoC and the Invention Board).

The hardware flow is illustrated in Figure 7.

Figure 7. Hardware Flow of LED_Blink PSoC Project

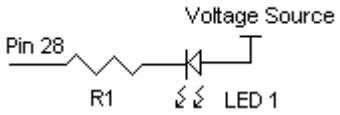


If you have an oscilloscope, download the project to the Invention Board and attach an oscilloscope probe to pin 20 of the Invention Board. The oscilloscope will display an approximate 2-Hz square wave output from the PSoC.

Similarly with an external LED and current-limiting resistor, you can use the 2-Hz square wave output to drive an LED. The easiest way to implement this is to do the following:

- Place the jumper on CON3 of the Invention Board to pins 2 and 3. This setting allows the Invention Board to be powered by an external source.
- Apply an external voltage source between the VX pin of the Invention Board (Pin 28) and V_{SS} (Pin 14).
- Connect the anode of the LED to the external voltage source. Connect the cathode of the LED to the current-limiting resistor. Connect the other end of the current-limiting resistor to P2[0]. This configuration uses the PSoC as a current sink for the LED. This was chosen because the PSoC can sink up to 25 mA through a GPIO pin (whereas it can only source 10 mA through a GPIO pin). Select the value of the current-limiting resistor to meet the maximum sink (or source) requirement of the PSoC. An appropriate resistor value is 470 ohms. This set up is illustrated in Figure 9.
- Verify that the LED blinks at the approximate 2-Hz rate.

Figure 8. Hardware Setup for Connecting an LED to the Invention Board



With this project, it is possible to change the period and/or pulse width of the 8-bit counter to create different frequency and duty-cycle square waves to drive the LED. This is done either through the Device Editor of PSoC Designer or through the user's firmware.

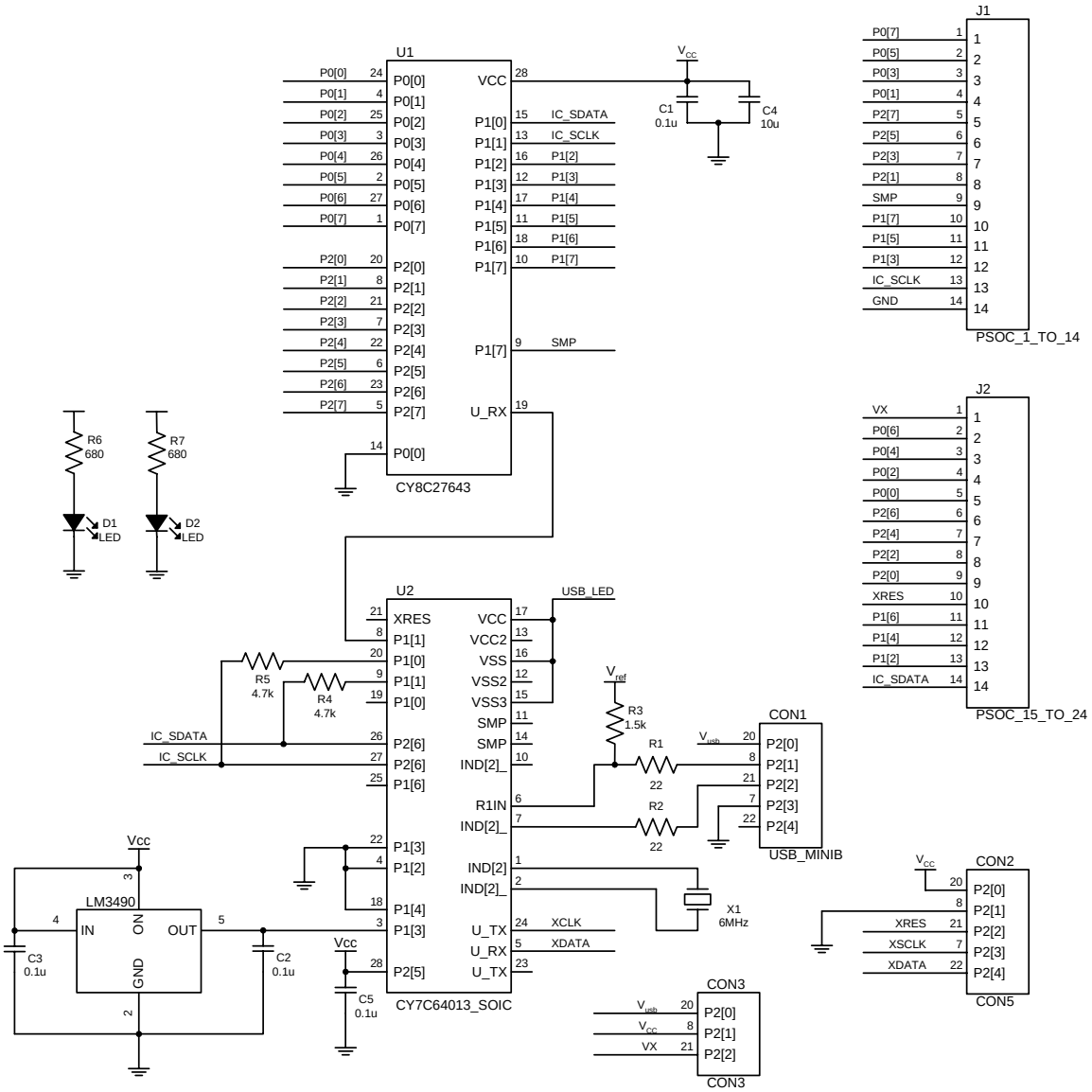
Project Support

There are several resources available for developers using the PSoC Invention Board. If the developer is unfamiliar with the PSoC mixed-signal array and would like to learn more, the best resource is to sign up for the PSoC Tele-Training Classes via the web. These classes introduce the developer to the PSoC along with providing hands-on training and the ability to ask questions to a PSoC expert. http://www.cypress.com/support/training.cfm.

Cypress also provides an online support system that allows developers to ask questions and/or upload their code for debugging assistance. http://www.cypress.com/support/mysupport.cfm.

Along with the online support system, Cypress maintains a PSoC user's forum that allows novice (and experienced) PSoC users to share assistance with other PSoC users. http://www.cypress.com/forums/.

Appendix 1: PSoC Invention Board Schematic



Appendix 2: Using the Invention Board for ISSP Programming

The PSoC Invention Board can also be used to program PSoC using the ISSP interface provided by CON2. In order to set up the Invention Board for ISSP programming, the following hardware and software must be used.

Hardware

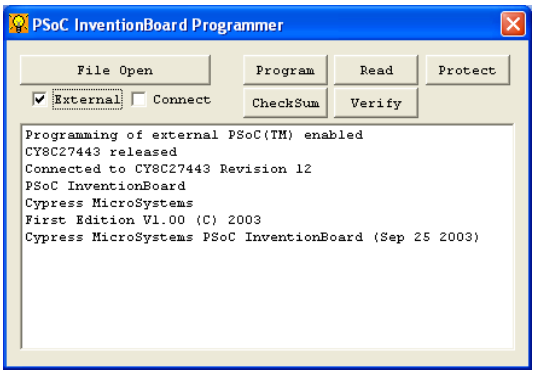
The header for CON2 must be installed on the Invention Board PCB. The recommended header can be purchased through Digikey. The Digikey part number is: WM4203-ND. The matching receptacle's part number is WM2003-ND.

Along with providing the necessary header and receptacle, it is necessary to construct the cable that connects the ISSP header to the external PSoC. The length of the programming cable should not be greater than 12 inches and should not be constructed from twisted, pair wires.

Software

The Invention Board Programming application is used for ISSP programming with the Invention Board. In the user interface of the programmer application, click on the External button. This button selects whether the programmer will program the PSoC soldered on the Invention board PCB, or ISSP program an external PSoC. After clicking the External button, the dialogue box will state that the programmer is configured for programming external PSoC devices. Figure A2 illustrates this option.

Figure A2. Invention Board Programmer Set for ISSP



The PSoC Invention Board is not intended for use as an ISSP production programmer. It does not contain the necessary hardware protection to withstand a production environment. Cypress does offer an ISSP programmer meant for production. The Cypress part number for the ISSP programmer is CY3207ISSP and is available through the Cypress Online Store at http://www.onfulfillment.com/cypressstore/.

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In March of 2007, Cypress recataloged all of its Application Notes using a new documentation number and revision code. This new documentation number and revision code (001-xxxxx, beginning with rev. **), located in the footer of the document, will be used in all subsequent revisions.

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