

## C8051F41x DEVELOPMENT KIT USER'S GUIDE

### 1. Kit Contents

The C8051F41x Development Kit contains the following items:

- C8051F410 Target Board
- C8051Fxxx Development Kit Quick-Start Guide
- AC to DC Power Adapter
- USB Debug Adapter (USB to Debug Interface)
- USB Cable
- CD-ROM

### 2. Hardware Setup Using a USB Debug Adapter

The target board is connected to a PC running the Silicon Laboratories IDE via the USB Debug Adapter as shown in Figure 1.

1. Connect the USB Debug Adapter to the **DEBUG** connector on the target board with the 10-pin ribbon cable.
2. Connect one end of the USB cable to the USB connector on the USB Debug Adapter.
3. Connect the other end of the USB cable to a USB Port on the PC.
4. Connect the ac/dc power adapter to power jack **P1** on the target board.

#### Notes:

- Use the **Reset** button in the IDE to reset the target when connected using a USB Debug Adapter.
- Remove power from the target board and the USB Debug Adapter before connecting or disconnecting the ribbon cable from the target board. Connecting or disconnecting the cable when the devices have power can damage the device and/or the USB Debug Adapter.

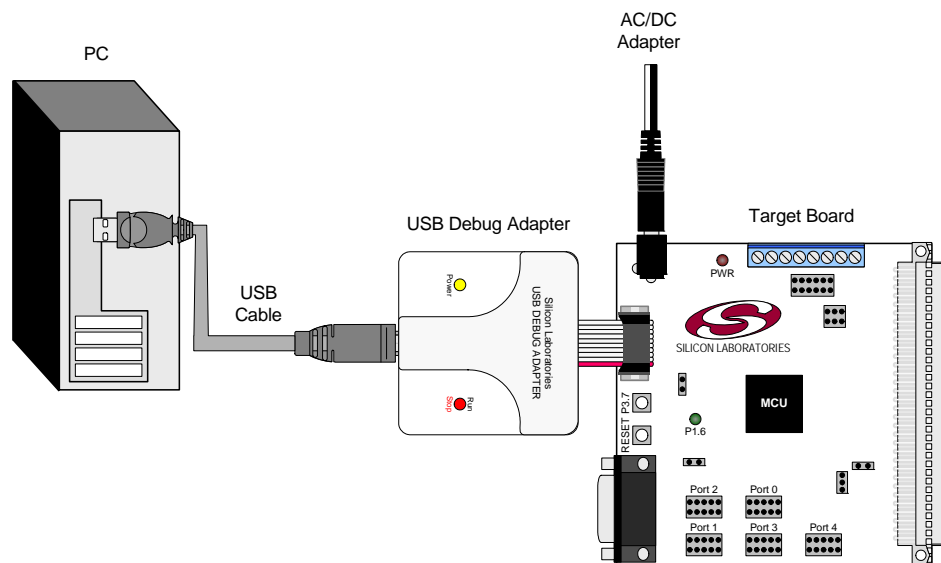
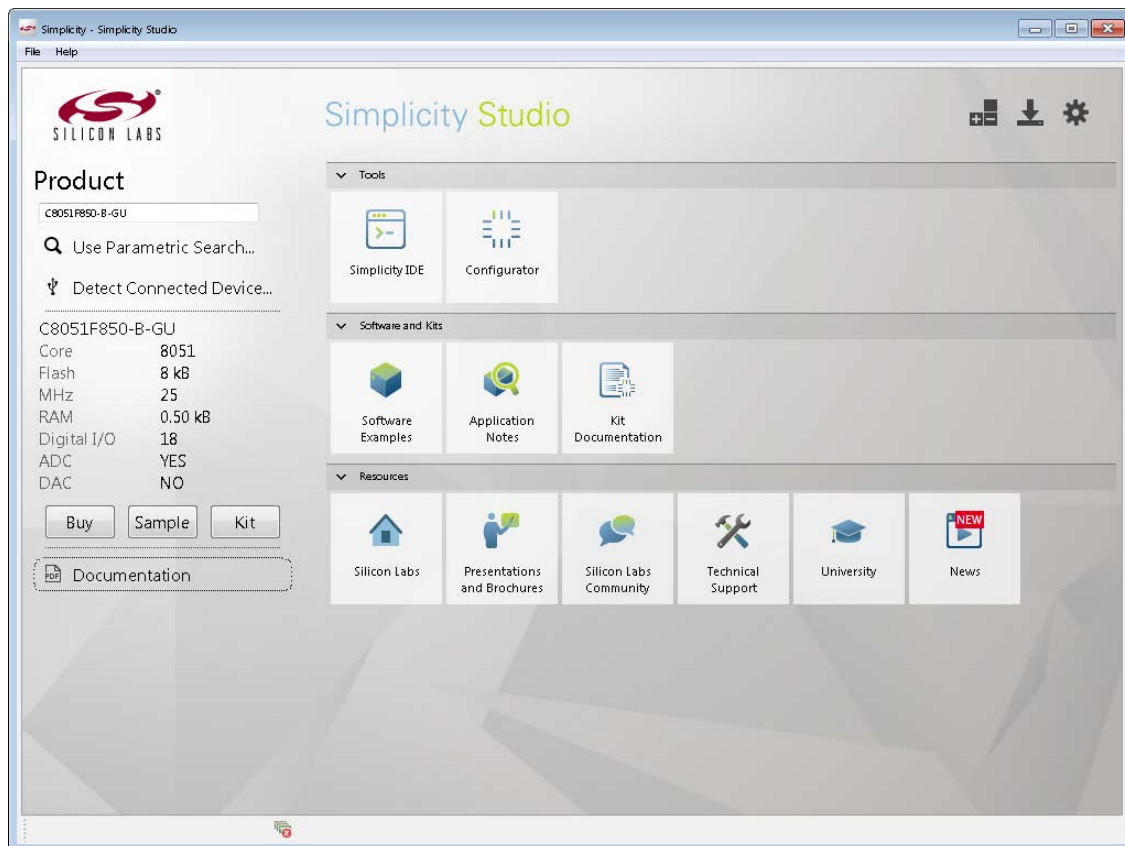


Figure 1. Hardware Setup Using a USB Debug Adapter

## 3. Software Setup

Simplicity Studio greatly reduces development time and complexity with Silicon Labs EFM32 and 8051 MCU products by providing a high-powered IDE, tools for hardware configuration, and links to helpful resources, all in one place.

Once Simplicity Studio is installed, the application itself can be used to install additional software and documentation components to aid in the development and evaluation process.



**Figure 2. Simplicity Studio**

The following Simplicity Studio components are required for the C8051F410 Development Kit:

- 8051 Products Part Support
- Simplicity Developer Platform

Download and install Simplicity Studio from [www.silabs.com/8bit-software](http://www.silabs.com/8bit-software) or [www.silabs.com/simplicity-studio](http://www.silabs.com/simplicity-studio). Once installed, run Simplicity Studio by selecting **Start**→**Silicon Labs**→**Simplicity Studio**→**Simplicity Studio** from the start menu or clicking the **Simplicity Studio** shortcut on the desktop. Follow the instructions to install the software and click **Simplicity IDE** to launch the IDE.

The first time the project creation wizard runs, the **Setup Environment** wizard will guide the user through the process of configuring the build tools and SDK selection.

In the **Part Selection** step of the wizard, select from the list of installed parts only the parts to use during development. Choosing parts and families in this step affects the displayed or filtered parts in the later device selection menus. Choose the C8051F41x family by checking the **C8051F41x** check box. Modify the part selection at any time by accessing the **Part Management** dialog from the **Window**→**Preferences**→**Simplicity Studio**→**Part Management** menu item.

Simplicity Studio can detect if certain toolchains are not activated. If the **Licensing Helper** is displayed after completing the **Setup Environment** wizard, follow the instructions to activate the toolchain.

## 3.1. Running Blinky

Each project has its own source files, target configuration, SDK configuration, and build configurations such as the **Debug** and **Release** build configurations. The IDE can be used to manage multiple projects in a collection called a workspace. Workspace settings are applied globally to all projects within the workspace. This can include settings such as key bindings, window preferences, and code style and formatting options. Project actions, such as build and debug are context sensitive. For example, the user must select a project in the **Project Explorer** view in order to build that project.

To create a project based on the Blinky example:

1. Click the **Simplicity IDE** tile from the Simplicity Studio home screen.
2. Click the **Create new project** link from the welcome screen or go to **File**→**New**→**Silicon Labs MCU Project**.
3. In the **Kit** drop-down, select **C8051F410 Development Kit**, in the **Part** drop-down, select **C8051F410**, and in the **SDK** drop-down, select the desired SDK. Click **Next**.
4. Select **Example** and click **Next**.
5. Under **C8051F410 Development Kit** in the **Blinky** folder, select **F41x Blinky** and click **Finish**.
6. Click on the project in the **Project Explorer** and click **Build**, the hammer icon in the top bar. Alternatively, go to **Project**→**Build Project**.
7. Click **Debug** to download the project to the hardware and start a debug session.
8. Press the **Resume** button to start the code running. The LED should blink.



9. Press the **Suspend** button to stop the code.



10. Press the **Reset the device** button to reset the target MCU.



11. Press the **Disconnect** button to return to the development perspective.



## 3.2. Simplicity Studio Help

Simplicity Studio includes detailed help information and device documentation within the tool. The help contains descriptions for each dialog window. To view the documentation for a dialog, click the question mark icon in the window:



This will open a pane specific to the dialog with additional details.

The documentation within the tool can also be viewed by going to **Help**→**Help Contents** or **Help**→**Search**.

# C8051F41x

## 3.3. Legacy 8-bit IDE

**Note:** Using the Simplicity Studio tools with the C8051F410 Development Kit is recommended. See section 3. "Software Setup," on page 2 for more information.

Download the 8-bit software from the website ([www.silabs.com/8bit-software](http://www.silabs.com/8bit-software)) or use the provided installer on the CD-ROM to install the software tools for the C8051F41x devices. After installation, examples can be found in ...\\Examples\\C8051F41x in the installation directory. At a minimum, the C8051F410 DK requires:

- **Silicon Labs IDE**—Software enabling initial evaluation, development, and debugging.
- **Configuration Wizard 2**—Initialization code generation software for the C8051F41x devices.
- **Keil C51 Tools**—Keil 8051 Compiler/Assembler/Linker toolchain.

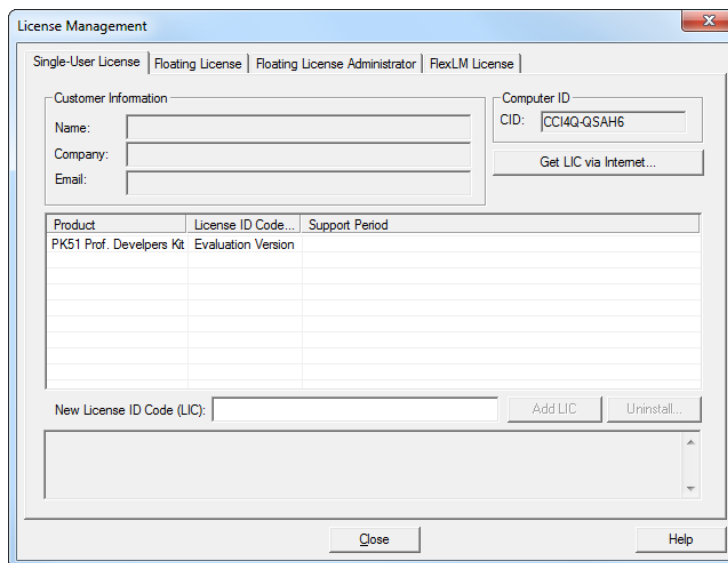
Other software available includes:

- **Keil  $\mu$ Vision Driver**—Driver for the Keil  $\mu$ Vision IDE that enables development and debugging on C8051Fxxx MCUs.
- **Flash Programming Utilities** and **MCU Production Programmer**—Programming utilities for the production line. More information on the available programming options can be found on the website: <http://www.silabs.com/products/mcu/Pages/ProgrammingOptions.aspx>.
- **ToolStick Development Tools**—Software and examples for the ToolStick development platform. More information on this platform can be found at [www.silabs.com/toolstick](http://www.silabs.com/toolstick).

The development kit includes the latest version of the C51 Keil 8051 toolset. This toolset is initially limited to a code size of 2 kB and programs start at code address 0x0800. After registration, the code size limit is removed entirely and programs will start at code address 0x0000.

To register the Keil toolset:

1. Find the **Product Serial Number** printed on the CD-ROM. If you no longer have this serial number, register on the Silicon Labs website ([www.silabs.com/8bit-software](http://www.silabs.com/8bit-software)) to obtain the serial number.
2. Open the Keil  $\mu$ Vision4 IDE from the installation directory with administrative privileges.
3. Select **File**→**License Management** to open the License Management window.



**Figure 3. Keil  $\mu$ Vision4 IDE License Management Window**

4. Click on the **Get LIC via Internet...** button to open the Obtaining a License IDE Code (LIC) window.
5. Press **OK** to open a browser window to the Keil website. If the window doesn't open, navigate to [www.keil.com/license/install.htm](http://www.keil.com/license/install.htm).
6. Enter the Silicon Labs **Product Serial Number** printed on the CD-ROM, along with any additional required

information.

7. Once the form is complete, click the **Submit** button. An email will be sent to the provided email address with the license activation code.
8. Copy the License ID Code (LIC) from the email.
9. Paste the LIC into the **New License ID Code (LIC)** text box at the bottom of the License Management window in  $\mu$ Vision4.
10. Press the **Add LIC** button. The window should now list the **PK51 Prof. Developers Kit for Silabs** as a licensed product.
11. Click the **Close** button.

# C8051F41x

## 4. Target Board

The C8051F41x Development Kit includes a target board with a C8051F410 device pre-installed for evaluation and preliminary software development. Numerous input/output (I/O) connections are provided to facilitate prototyping using the target board. Refer to Figure 4 for the locations of the various I/O connectors.

- P1 Power connector (accepts input from 7 to 15 VDC unregulated power adapter)
- J1 22-pin Expansion I/O connector
- J3 Port I/O Configuration Jumper Block
- J4 DEBUG connector for Debug Adapter interface
- J5 DB-9 connector for UART0 RS232 interface
- J6 Analog I/O terminal block
- J7 Connector for IDAC0 voltage circuit
- J8 USB Debug Adapter target board power connector
- J9, J10 External crystal enable connectors
- J11 Connector for IDAC1 voltage circuit
- J12 Connector block for Thermistor circuitry
- J13, J14 ADC external voltage reference connectors

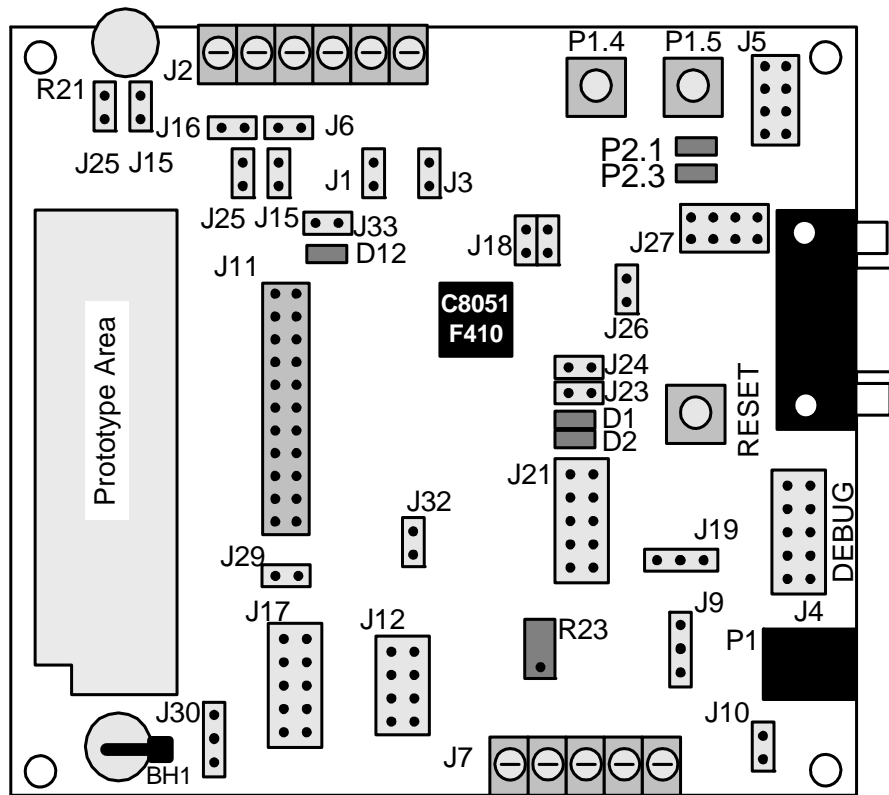


Figure 4. C8051F410 Target Board

## 4.1. System Clock Sources

The C8051F410 device installed on the target board features a calibrated programmable internal oscillator which is enabled as the system clock source on reset. After reset, the internal oscillator operates at a frequency of 191.4 kHz ( $\pm 2\%$ ) by default but may be configured by software to operate at other frequencies. Therefore, in many applications an external oscillator is not required. However, if you wish to operate the C8051F410 device at a frequency not available with the internal oscillator, an external crystal may be used. Refer to the C8051F41x data sheet for more information on configuring the system clock source.

The target board is designed to facilitate the installation of an external crystal. Remove shorting blocks at headers J9 and J18 and install the crystal at the pads marked Y2. Install a 10 M $\Omega$  resistor at R4 and install capacitors at C44 and C43 using values appropriate for the crystal you select. Refer to the C8051F41x data sheet for more information on the use of external oscillators. The target board also has a 32.768 kHz watch crystal installed to provide a timebase for the smRTClock. Jumper J26 may be used to short the XTAL3 and XTAL4 pins if internal clock mode is desired.

## 4.2. Power Options

The C8051F41x Target Board has many power options. This allows the user to exercise the different operating modes of the C8051F410. The board has 2 voltage regulators. A 3.3 V LDO and a 1.2–5.25 V variable regulator.

To use the 3.3 V regulator, pin 2–3 of J9 should be shorted and a jumper installed in J10.

To use the variable regulator, pin 1–2 of J19 should be shorted and an output voltage should be selected using J21. After selecting the appropriate voltage, pin 1–2 of J21 should be shorted to enable the output of the variable regulator. If the voltage "VAR" is selected, the potentiometer R23 should be adjusted until the desired voltage is reached. The input to the variable regulator can be obtained from the unregulated 9 V supply or from the 5 V USB VBUS supply available when using a USB debug adapter.

**Note: Before enabling either voltage regulator, the user should check the 4 supply rail selection headers (J29+J30, J17, J12, J31+32) to ensure the correct voltage is being routed to the correct power pin. An incorrect jumper setting may permanently damage the board. Note that VDD cannot exceed 2.5 V and is typically derived from the on-chip regulator. Do not connect the 5.25 or 3.3 V output directly to VDD.**

The three power LEDs for VIO, VREG, and VDD indicate if the appropriate supply rail is connected to a power supply. Check to make sure all supply rails (with exception of VREG if not using the on-chip regulator) are powered.

For the VIO voltage rail, the user may choose from the 3 V regulator (+3 VD), the variable regulator, or the on-chip regulator. The selections are marked on the target board silkscreen.

For the VREG on-chip voltage regulator input, the user may choose from the 3 V regulator (+3VD), the 5 V USB VBUS source obtained from the USB debug adapter (5VEC3), or from the variable regulator (VREG). The selections are marked on the target board silkscreen.

For VDD, the user may choose the output of the on-chip regulator (VDD\_) or the output of the variable regulator (VREG).

## 4.3. Switches and LEDs

Three switches are provided on the target board. Switch SW1 is connected to the RESET pin of the C8051F410. Pressing SW1 puts the device into its hardware-reset state. Switch SW2 and SW3 are connected to the C8051F410's general purpose I/O (GPIO) pins through headers. Pressing SW2 or SW3 generates a logic low signal on the port pin. Remove the shorting block from the jumper J5 to disconnect SW2 and/or SW3 from their associated port pins. The port pin signals are also routed to pins on the J11 I/O connector. See Table 1 for the port pins and headers corresponding to each switch.

Three LEDs are also provided on the target board. The red LED labeled PWR is used to indicate a power connection to the target board. The green LEDs labeled with port pin names are connected to the C8051F410's GPIO pins through headers. Remove the shorting blocks from the headers to disconnect the LEDs from the port pins. The port pin signals are also routed to pins on the J1 I/O connector. See Table 1 for the port pins and headers corresponding to each LED.

**Table 1. Target Board I/O Descriptions**

Description	I/O	Jumper
SW1	Reset	none
SW2	P1.4	J5[3–4]
SW3	P1.5	J5[7–8]
Green LED D3	P2.1	J5[1–2]
Green LED D5	P2.3	J5[5–6]
Red LED D1	VREGIN	J24
Red LED D2	VDD	J23
Red LED D12	VIO	J33

#### 4.4. Expansion I/O Connector (J1)

The 24-pin Expansion I/O connector J11 provides access to all signal pins of the C8051F410 device. A small through-hole prototyping area is also provided. All I/O signals routed to connector J1 are also routed to through-hole connection points between J11 and the prototyping area (see Figure 4 on page 6). Each connection point is labeled indicating the signal available at the connection point. See Table 2 for a list of pin descriptions for J1.

**Table 2. J1 Pin Descriptions**

Pin #	Description	Pin #	Description
1	P0.0	13	P1.4
2	P0.1	14	P1.5
3	P0.2	15	P1.6
4	P0.3	16	P1.7
5	P0.4	17	P2.0
6	P0.5	18	P2.1
7	P0.6	19	P2.2
8	P0.7	20	P2.3
9	P1.0	21	P2.4
10	P1.1	22	P2.5
11	P1.2	23	P2.6
12	P1.3	24	P2.7



#### 4.5. Target Board DEBUG Interface (J4)

The DEBUG connector (J4) provides access to the DEBUG (C2) pins of the C8051F410. It is used to connect the Serial Adapter or the USB Debug Adapter to the target board for in-circuit debugging and Flash programming. Table 3 shows the DEBUG pin definitions.

**Table 3. DEBUG Connector Pin Descriptions**

Pin #	Description
1	+3 VD (+3.3 VDC)
2, 3, 9	GND (Ground)
4	C2D
5	/RST (Reset)
6	P3.0
7	C2CK
8	Not Connected
10	USB Power

#### 4.6. Serial Interface (J5)

A RS232 transceiver circuit and DB-9 (J5) connector are provided on the target board to facilitate serial connections to UART0 of the C8051F410. The TX, RX, RTS and CTS signals of UART0 may be connected to the DB-9 connector and transceiver by installing shorting blocks on header J3.

J27[1–2]- Install shorting block to connect UART0 TX (P0.4) to transceiver.

J27[3–4]- Install shorting block to connect UART0 RX (P0.5) to transceiver.

J27[5–6]- Install shorting block to connect UART0 RTS (P1.4) to transceiver.

J27[7–8]- Install shorting block to connect UART0 CTS (P1.5) to transceiver.

#### 4.7. Analog I/O (J6)

Many of the C8051F410 target device's port pins are connected to the J2 terminal block. Connections for VDDA, AGND, ADC external voltage references, IDAC outputs and ADC inputs are available. Refer to Table 4 for the J6 terminal block connections.

**Table 4. J6 Terminal Block Pin Descriptions**

Pin #	Description
1	P0.0/IDAC0
2	P0.1/IDAC1
3	VREFIN
4	GND
5	AIN0
6	AIN1

## 4.8. IDAC Connectors (J7, J11)

The C8051F410 target board also features two Current-to-Voltage 750  $\Omega$  load resistors that may be connected to the 2-bit current-mode Digital-to-Analog Converters (IDACs) on port pins P1.0 and P1.1. Install a shorting block on J13 to connect the IDAC0/P1.0 pin of the target device to a load resistor. Install a second shorting block on J14 to connect the IDAC1/P1.1 pin of the target device to a load resistor. The IDAC signals are then routed to the J1 and J13 and J14 connectors.

## 4.9. USB Debug Adapter Target Board Power Connector (J8)

The USB Debug Adapter includes a connection to provide power to the target board. This connection is routed from J4[10] to J8[1]. Place a shorting block at header J8[2–3] to power the board directly from an ac/dc power adapter. Place a shorting block at header J8[1-2] to power the board from the USB Debug Adapter. The second option is not supported with either the EC1 or EC2 Serial Adapters.

## 4.10. smaRTClock (Real Time Clock)

The C8051F41x Target Board is designed for developing system using the on-chip smaRTClock. A 32 kHz watch crystal is installed in Y1 and a battery holder (BH1) is installed for use as a backup power source. To connect the battery to the VBAT input on the MCU, connect pin 1 and 2 of J30 and short J29. The variable voltage regulator with potentiometer (R23) may also be used to generate the battery voltage and simulate a battery in its various charge conditions. See the C8051F41x data sheet for more details about the smaRTClock.

5. Schematics

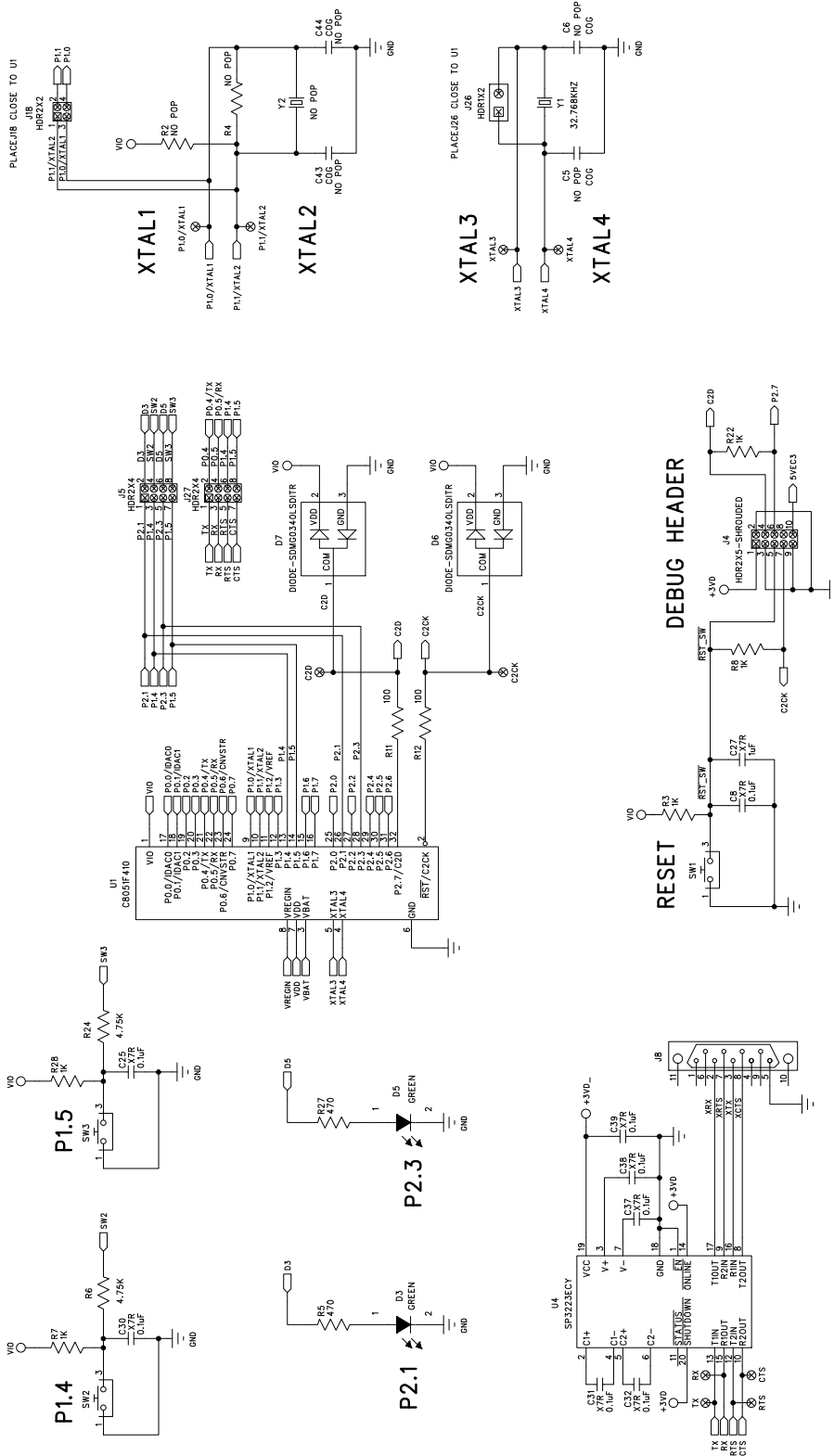
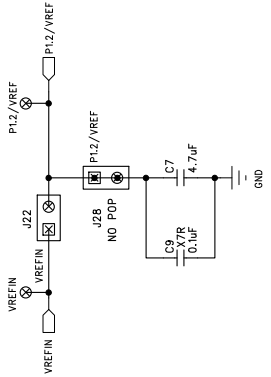
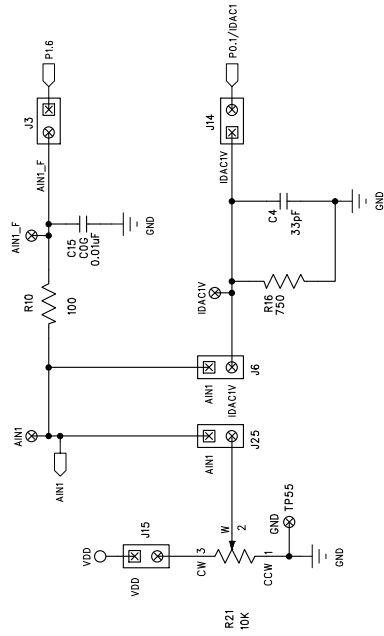
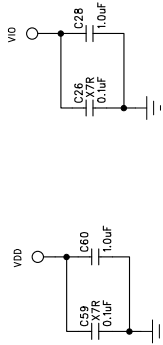
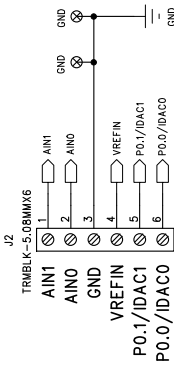


Figure 5. C8051F410 Target Board Schematic (Page 1 of 3)



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LOCATE THESE CAPS CLOSE TO U1

## TB HEADERS

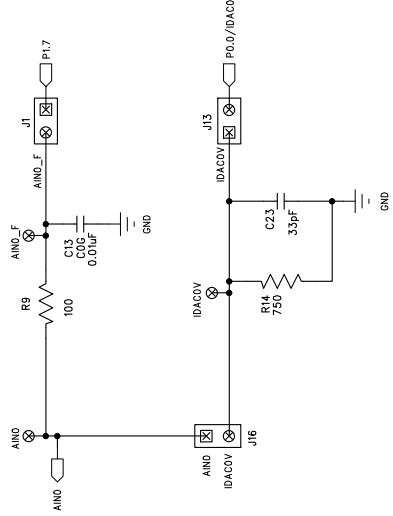
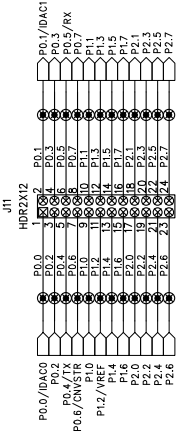


Figure 6. C8051F410 Target Board Schematic (Page 2 of 3)

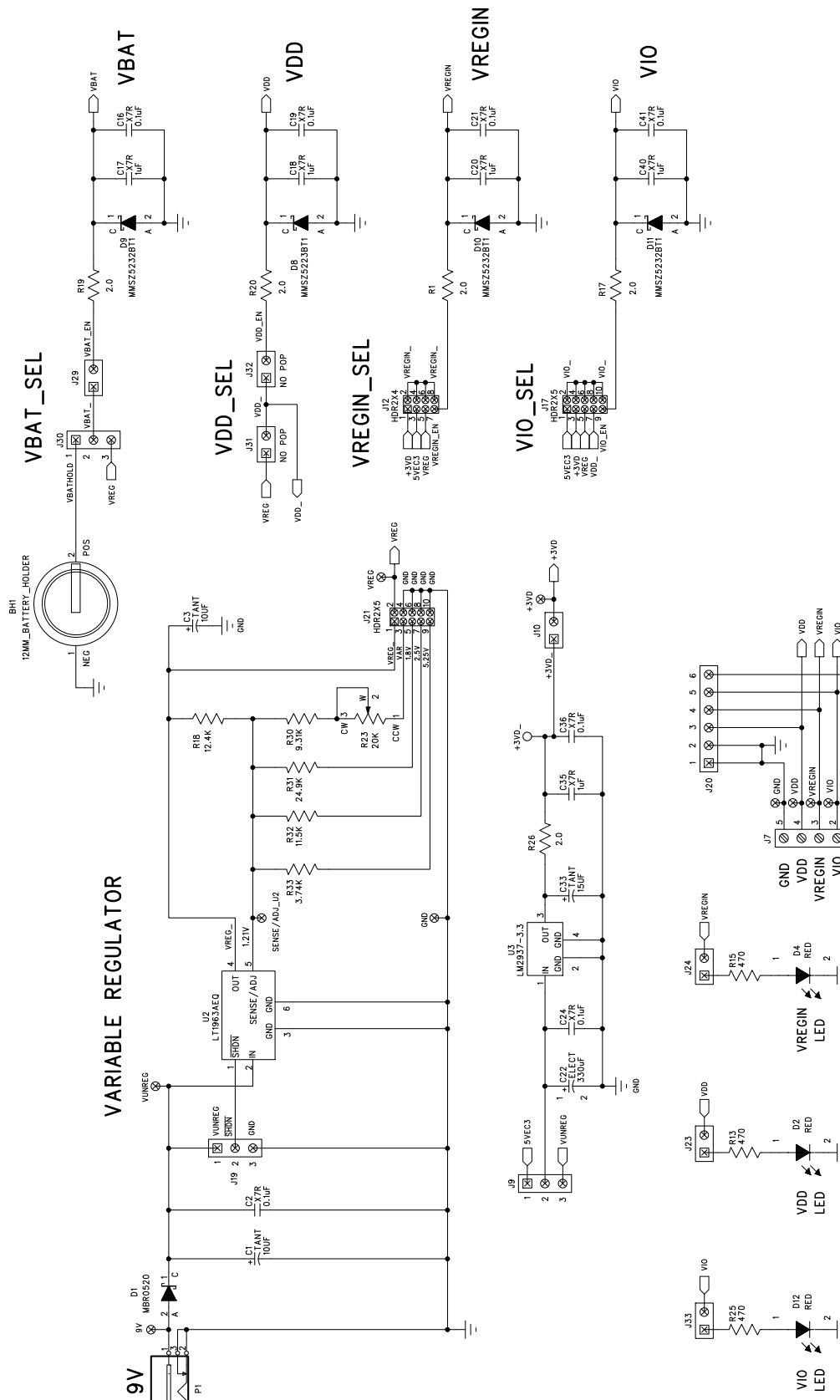


Figure 7. C8051F410 Target Board Schematic (Page 3 of 3)

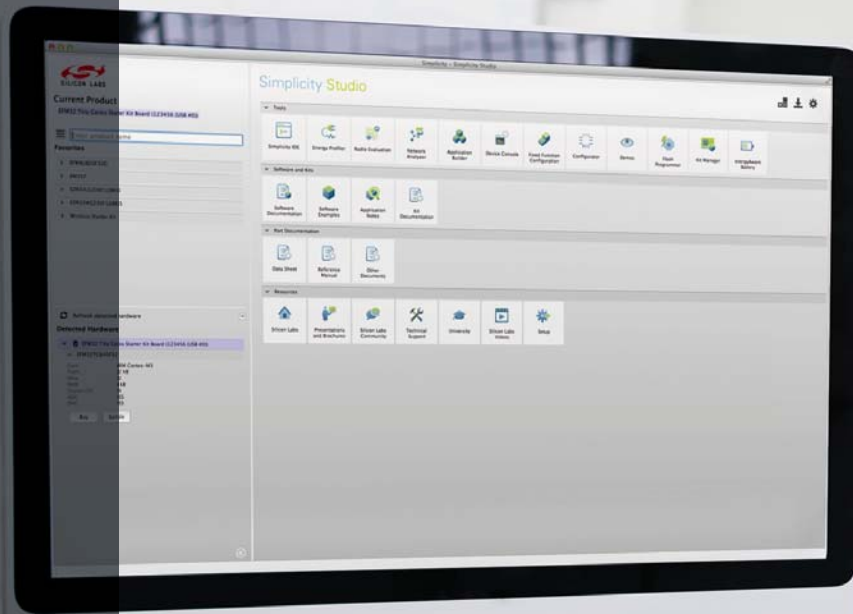
## DOCUMENT CHANGE LIST

### Revision 0.2 to Revision 0.3

- Removed Section 9. USB Debug Adapter. See USB Debug Adapter User's Guide.

### Revision 0.3 to Revision 0.4

- Updated 3. "Software Setup," on page 2.



## Simplicity Studio

One-click access to MCU and wireless tools, documentation, software, source code libraries & more. Available for Windows, Mac and Linux!



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**SILICON LABS**

Silicon Laboratories Inc.  
 400 West Cesar Chavez  
 Austin, TX 78701  
 USA

<http://www.silabs.com>