C8051F530A-DK

C8051F530A Development Kit User's Guide

1. Relevant Devices

The C8051F530A Development Kit is intended as a development platform for the microcontrollers in the C8051F52xA-53xA MCU family. The members of this MCU family are C8051F520A, C8051F521A, C8051F523A, C8051F524A, C8051F526A, C8051F527A, C8051F530A, C8051F531A, C8051F533A, C8051F534A, C8051F536A, and C8051F537A.

Notes:

- The target board included in this kit is provided with two pre-soldered C8051F530A-IT MCUs (TSSOP-20 package).
- Code developed on the C8051F530A can be easily ported to the other members of this MCU family.
- Refer to the C8051F52x/52xA/53x/53xA data sheet for the differences between the members of this MCU family.

2. Kit Contents

The C8051F530A Development Kit contains the following items:

- C8051F530A Target Board
- C8051Fxxx Development Kit Quick-Start Guide
- Silicon Laboratories IDE and Product Information CD-ROM. CD content includes:
    - Silicon Laboratories Integrated Development Environment (IDE)
    - Keil 8051 Development Tools (macro assembler, linker, evaluation C compiler)
    - Source code examples and register definition files
    - Documentation
    - C8051F52xA-53xA Development Kit User's Guide (this document)
- Optional Third Party Tools CD
- AC to DC Power Adapter
- USB Debug Adapter (USB to Debug Interface)
- USB Cable

The development kit target board contains two C8051530A microcontrollers that can communicate through a LIN network. One of the C8051F530A (U2) can also be connected to a CP2102 USB to UART bridge and directly connected to two analog signals and a Voltage Reference Signal Input.

The kit includes one USB Debug Adapter. Additionally, a second USB Debug Adapter and a second instance of the Silicon Labs IDE can be used to communicate with both microcontrollers on the board at the same time using only one PC.

3. Software Overview

All software required to develop firmware and communicate with the target microcontroller is included in the CD-ROM. The CD-ROM also includes other useful software.

Below is the software necessary for firmware development and communication with the target microcontroller:

- Silicon Laboratories Integrated Development Environment (IDE)
- Keil 8051 Development Tools (macro assembler, linker, evaluation C compiler)

Other useful software provided on the CD-ROM includes the following:

- Configuration Wizard 2
- Keil uVision Drivers
- CP210x USB to UART Virtual COM Port (VCP) Drivers

3.1. Software Installation

The included CD-ROM contains the Silicon Laboratories Integrated Development Environment (IDE), Keil software 8051 tools and additional documentation. Insert the CD-ROM into your PC's CD-ROM drive. An installer will automatically launch, allowing you to install the IDE software or read documentation by clicking buttons on the Installation Panel. If the installer does not automatically start when you insert the CD-ROM, run *autorun.exe* found in the root directory of the CD-ROM. Refer to the *ReleaseNotes.txt* file on the CD-ROM for the latest information regarding known problems and restrictions. After installing the software, see the following sections for information regarding the software and running one of the demo applications.

3.2. CP210x USB to UART VCP Driver Installation

The C8051F530A Target Board includes a Silicon Laboratories CP2102 USB-to-UART Bridge Controller. Device drivers for the CP2102 need to be installed before PC software (such as HyperTerminal) can communicate with the target board over the USB connection. If the "Install CP210x Drivers" option was selected during installation, this will launch a driver "unpacker" utility.

1. Follow the steps to copy the driver files to the desired location. The default directory is *C:\SiLabs\MCU\CP210x*.
2. The final window will give an option to install the driver on the target system. Select the "Launch the CP210x VCP Driver Installer" option if you are ready to install the driver.
3. If selected, the driver installer will now launch, providing an option to specify the driver installation location. After pressing the "Install" button, the installer will search your system for copies of previously installed CP210x Virtual COM Port drivers. It will let you know when your system is up to date. The driver files included in this installation have been certified by Microsoft.
4. If the "Launch the CP210x VCP Driver Installer" option was not selected in step 3, the installer can be found in the location specified in step 2, by default *C:\SiLabs\MCU\CP210x\Windows_2K_XP_S2K3_Vista*. At this location, run *CP210xVCPInstaller.exe*.
5. To complete the installation process, connect the included USB cable between the host computer and the USB connector (P1) on the C8051F530A Target Board. Windows will automatically finish the driver installation. Information windows will pop up from the taskbar to show the installation progress.
6. If needed, the driver files can be uninstalled by selecting "Silicon Laboratories CP210x USB to UART Bridge (Driver Removal)" option in the "Add or Remove Programs" window.

3.3. Silicon Laboratories IDE

The Silicon Laboratories IDE integrates a source-code editor, a source-level debugger, and an in-system Flash programmer. See Section 5., "Using the Keil Software 8051 Tools with the Silicon Laboratories IDE," on page 6 for detailed information on how to use the IDE. The Keil Evaluation Toolset includes a compiler, linker, and assembler and easily integrates into the IDE. The use of third-party compilers and assemblers is also supported.

3.3.1. IDE System Requirements

The Silicon Laboratories IDE requirements:

- Pentium-class host PC running Microsoft Windows 2000 or newer.
- One available USB port.
- 64 MB RAM and 40 MB free HD space recommended.

3.3.2. Third Party Toolsets

The Silicon Laboratories IDE has native support for many 8051 compilers. The full list of natively supported tools is as follows:

- Keil
- IAR
- Raisonance
- Tasking
- Hi-Tech
- SDCC

The demo applications for the C8051F530A Target Board are written to work with the Keil and SDCC toolsets.

3.4. Keil Evaluation Toolset

3.4.1. Keil Assembler and Linker

The Keil demonstration toolset assembler and linker place no restrictions on code size.

3.4.2. Keil Evaluation C51 C Compiler

The evaluation version of the C51 compiler is the same as the full version with the following limitations: (1) Maximum 4 kB code generation, (2) There is no floating point library included. When installed from the CD-ROM, the C51 compiler is initially limited to a code size of 2 kB, and programs start at code address 0x0800. Refer to the Application Note “AN104: Integrating Keil Tools into the Silicon Labs IDE" for instructions to change the limitation to 4 kB and have the programs start at code address 0x0000.

3.5. Configuration Wizard 2

The Configuration Wizard 2 is a code generation tool for all of the Silicon Laboratories devices. Code is generated through the use of dialog boxes for each of the device's peripherals.

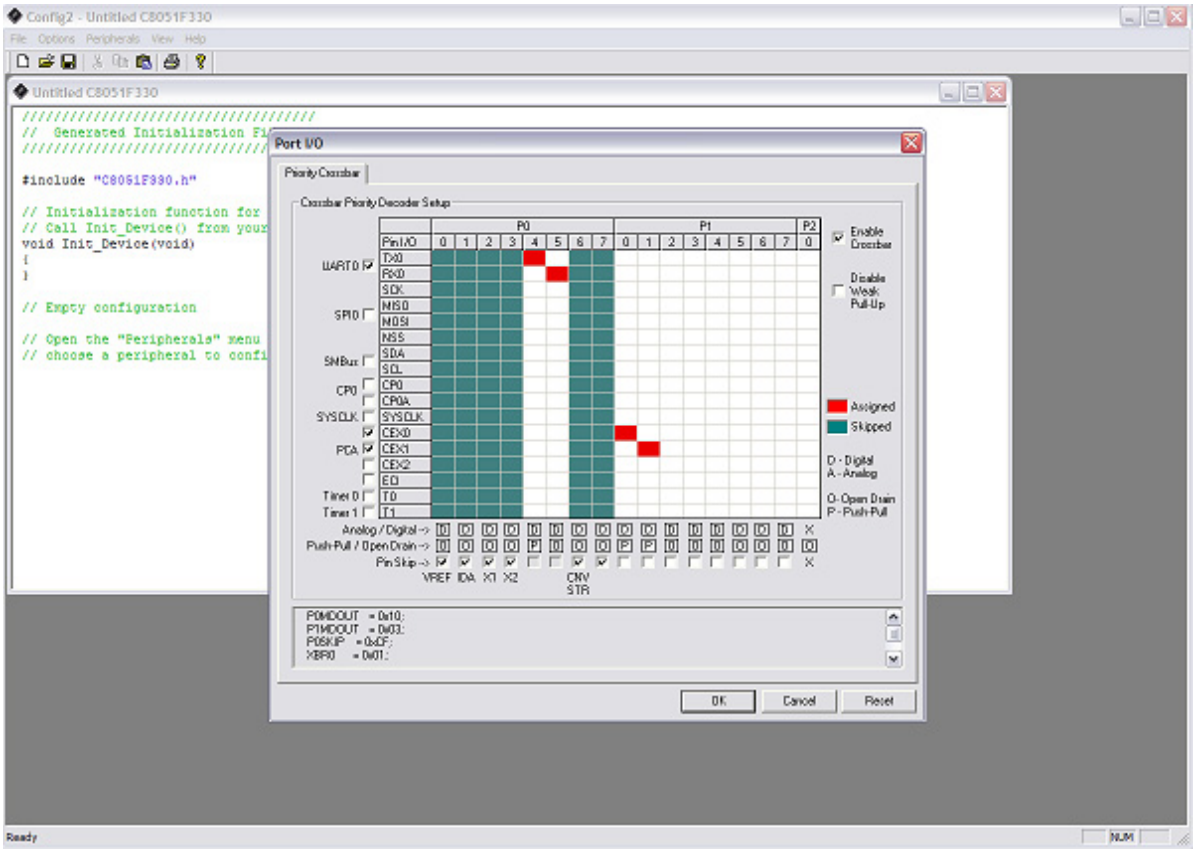

Figure 1. Configuration Wizard 2 Utility

The Configuration Wizard 2 utility helps accelerate development by automatically generating initialization source code to configure and enable the on-chip resources needed by most design projects. In just a few steps, the wizard creates complete startup code for a specific Silicon Laboratories MCU. The program is configurable to provide the output in C or assembly language. For more information, refer to the Configuration Wizard documentation. Documentation and software is available on the kit CD and from the downloads webpage: www.silabs.com/mcudownloads.

3.6. Keil µVision2 and µVision3 Silicon Laboratories Drivers

As an alternative to the Silicon Laboratories IDE, the µVision debug driver allows the Keil µVision2 and µVision3 IDEs to communicate with Silicon Laboratories on-chip debug logic. In-system Flash memory programming integrated into the driver allows for rapidly updating target code. The µVision2 and µVision3 IDEs can be used to start and stop program execution, set breakpoints, check variables, inspect and modify memory contents, and single-step through programs running on the actual target hardware. For more information, refer to the µVision driver documentation. The documentation and software are available from the downloads webpage: www.silabs.com/mcudownloads.

4. 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 2.

1. Connect the USB Debug Adapter to one of the DEBUG connectors on the target board (HDR1 or HDR2) with the 10-pin ribbon cable. The recommended connection is to the HDR2 (connected to U2) as this microcontroller can be connected to the CP2102 USB to UART bridge.
2. Verify that shorting blocks are installed on J13 and J14 to supply power to the target devices.
3. Connect one end of the USB cable to the USB connector on the USB Debug Adapter.
4. Connect the other end of the USB cable to a USB Port on the PC.
5. Connect the ac/dc power adapter to power jack P5 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.

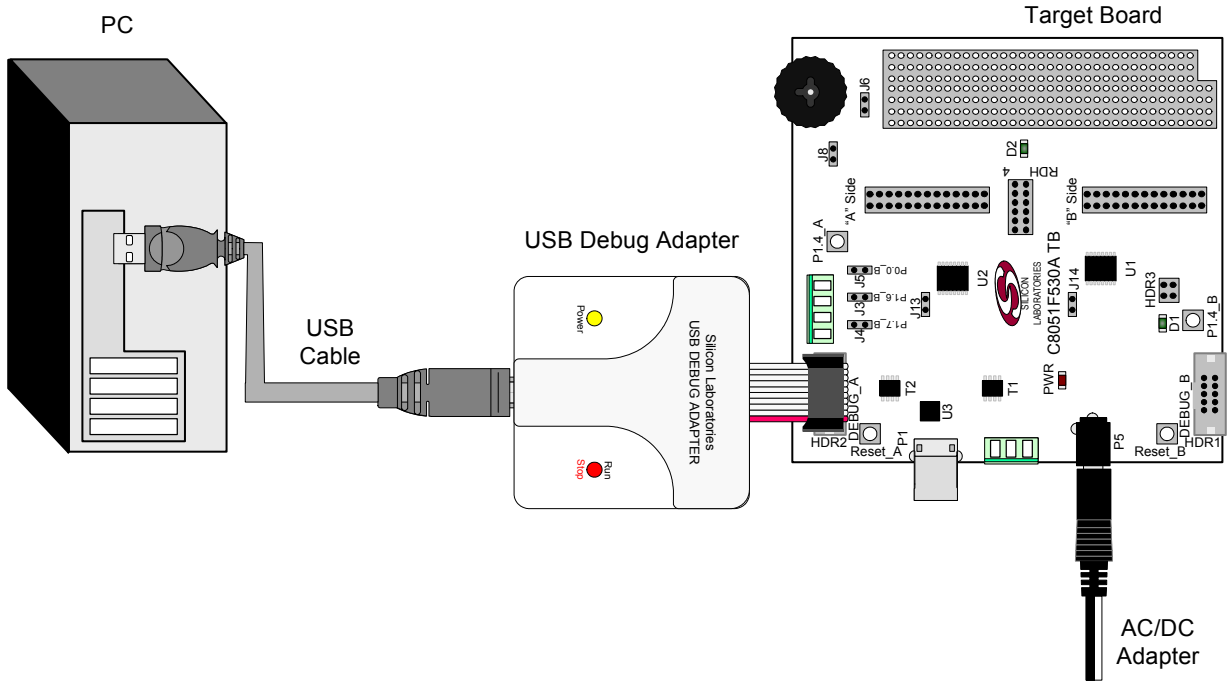

Figure 2. Hardware Setup using a USB Debug Adapter

5. Using the Keil Software 8051 Tools with the Silicon Laboratories IDE

To perform source-level debugging with the IDE, you must configure the Keil 8051 tools to generate an absolute object file in the OMF-51 format with object extensions and debug records enabled. Build the OMF-51 absolute object file by calling the Keil 8051 tools at the command line (e.g. batch file or make file) or by using the project manager built into the IDE. The default configuration when using the Silicon Laboratories IDE project manager enables object extension and debug record generation. Refer to Application Note "AN104: Integrating Keil 8051 Tools into the Silicon Labs IDE" in the "*SiLabs\MCU\Documentation\ApplicationNotes*" directory for additional information on using the Keil 8051 tools with the Silicon Laboratories IDE.

To build an absolute object file using the Silicon Laboratories IDE project manager, you must first create a project. A project consists of a set of files, IDE configuration, debug views, and a target build configuration (list of files and tool configurations used as input to the assembler, compiler, and linker when building an output object file).

The following sections illustrate the steps necessary to manually create a project with one or more source files, build a program, and download it to the target in preparation for debugging. (The IDE will automatically create a single-file project using the currently open and active source file if you select **Build/Make Project** before a project is defined.)

5.1. Creating a New Project

1. Select **Project→New Project** to open a new project and reset all configuration settings to default.
2. Select **File→New File** to open an editor window. Create your source file(s) and save the file(s) with a recognized extension, such as .c, .h, or .asm, to enable color syntax highlighting.
3. Right-click on "New Project" in the **Project Window**. Select **Add files to project**. Select files in the file browser and click Open. Continue adding files until all project files have been added.
4. For each of the files in the **Project Window** that you want assembled, compiled, and linked into the target build, right-click on the file name and select **Add file to build**. Each file will be assembled or compiled as appropriate (based on file extension) and linked into the build of the absolute object file.
5. If a project contains a large number of files, the "Group" feature of the IDE can be used to organize. Right-click on "New Project" in the **Project Window**. Select **Add Groups to project**. Add pre-defined groups or add customized groups. Right-click on the group name and choose **Add file to group**. Select files to be added. Continue adding files until all project files have been added.

5.2. Building and Downloading the Program for Debugging

1. Once all source files have been added to the target build, build the project by clicking on the **Build/Make Project** button in the toolbar or selecting **Project→Build/Make Project** from the menu.

Note: After the project has been built the first time, the **Build/Make Project** command will only build the files that have been changed since the previous build. To rebuild all files and project dependencies, click on the **Rebuild All** button in the toolbar or select **Project→Rebuild All** from the menu.

2. Before connecting to the target device, several connection options may need to be set. Open the **Connection Options** window by selecting **Options→Connection Options . . .** in the IDE menu. First, select the appropriate adapter in the "Serial Adapter" section. Next, the correct "Debug Interface" must be selected. C8051F52xA-53xA family devices use the Silicon Labs 2-wire (C2) debug interface. Once all the selections are made, click the OK button to close the window.
3. Click the **Connect** button in the toolbar or select **Debug→Connect** from the menu to connect to the device.
4. Download the project to the target by clicking the **Download Code** button in the toolbar.

Note: To enable automatic downloading if the program build is successful, select **Enable automatic connect/download after build** in the **Project→Target Build Configuration** dialog. If errors occur during the build process, the IDE will not attempt the download.

5. Save the project when finished with the debug session to preserve the current target build configuration, editor settings, and the location of all open debug views. To save the project, select **Project→Save Project As . . .** from the menu. Create a new name for the project and click on **Save**.

6. Example Source Code

Example source code and register definition files are provided in the "*SiLabs\MCU\Examples\C8051F52xA_53xA*" directory during IDE installation. These files may be used as a template for code development. Example applications include a blinking LED example which configures the green LED on the target board to blink at a fixed rate.

6.1. Register Definition Files

Register definition files *C8051F520A.inc* and *C8051F520A_defs.h* define all SFR registers and bit-addressable control/status bits. A macro definition header file *compiler_defs.h* is also included and is required to be able to use the *C8051F520A_defs.h* header file with various tool chains. These files are installed by default into the "*SiLabs\MCU\Examples\C8051F52xA_53xA\Header_Files*" directory during IDE installation. The register and bit names are identical to those used in the C8051F52x/52xA/53x/53xA data sheet. The register definition files are also installed in the default search path used by the Keil Software 8051 tools. Therefore, when using the Keil 8051 tools included with the development kit (A51, C51), it is not necessary to copy a register definition file to each project's file directory.

6.2. Blinking LED Example

The example source files *F530A_Blinky.asm* and *F530A_Blinky.c* installed in the default directory "*SiLabs\MCU\Examples\C8051F52xA_53xA\Blinky*" show examples of several basic C8051F52xA-53xA functions. These include disabling the watchdog timer (WDT), configuring the Port I/O crossbar, configuring a timer for an interrupt routine, initializing the system clock, and configuring a GPIO port. When compiled/assembled and linked, this program flashes the green LED on the C8051F530A Target Board associated with the microcontroller about five times a second using the interrupt handler with a C8051F530A timer.

7. Target Board

The C8051F52xA-53xA Development Kit includes a target board with two C8051F530A devices 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 3 for the locations of the various I/O connectors.

P5	Power connector (Accepts input from 7 to 15 VDC unregulated power adapter.)
PWR	Red Power-on LED (D3)
TB1	LIN connector
U5	5 V Voltage Regulator

"A" Side:

J2	28-pin Expansion I/O connector for U2
HDR2	Debug connector for Debug Adapter Interface
P1.3_A	Green LED (D2)
Reset_A	Reset button
P1.4_A	Push button
R32	Potentiometer for P1.2_A
J6, J8	Connects R32 (potentiometer) to U2 and +5 V
J13	Connects power to U2
J11, J12	Connects external crystal to U2 pins P0.7_A and P1.0_A
J3	Connects analog channel 1 to U2 P1.6_A
J4	Connects analog channel 2 to U2 P1.7_A
J5	Connects VREFIN to U2 P0.0_A
TB2	Analog input connector
HDR4	Connector block for serial port connection, Green LED, and push-button
U3	Silicon Laboratories CP2102 USB-to-UART Bridge
P1	USB connector to serial interface (CP2102)
USB ACTIVE	Red USB Active LED (D4) (CP2102)
T2	LIN transceiver
U2	C8051F530A "A" Side

"B" Side:

J1	26-pin Expansion I/O connector for U1
HDR1	Debug connector for Debug Adapter Interface
P1.3_B	Green LED (D1)
Reset_B	Reset button
P1.4_B	Push button
J14	Connects power to U1
J9, J10	Connects external crystal to U1 pins P0.7_B and P1.0_B
HDR3	Green LED and push-button connector block
T1	LIN transceiver
U1	C8051F530A "B" Side

7.1. Target Board Shorting Blocks: Factory Defaults

The C8051F530A target board comes from the factory with pre-installed shorting blocks on many headers. Figure 3 shows the positions of the factory default shorting blocks.

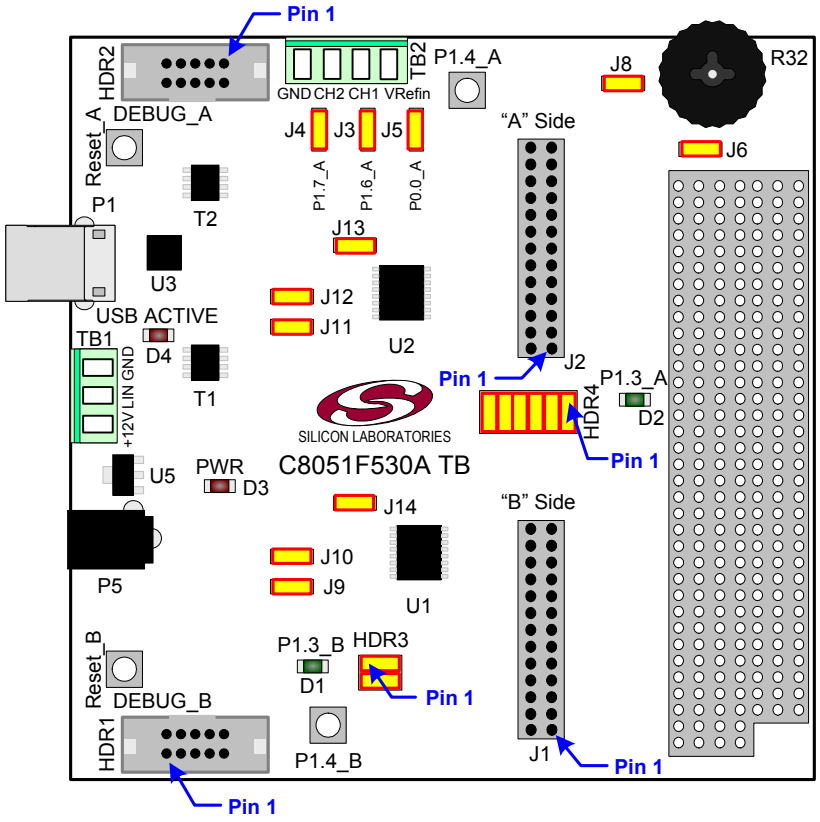

Figure 3. C8051F530A Target Board

7.2. System Clock Sources

The C8051F530A 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 (±0.5%) 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 C8051F530A device at a frequency not available with the internal oscillator, an external crystal may be used. Refer to the C8051F52x/52xA/53x/53xA data sheet for more information on configuring the system clock source.

The target board is designed to facilitate the installation of external crystals. Install the crystals at the pads marked Y1 or Y2. Install a 10 MΩ resistor at R17 or R22 and install capacitors at C29 and C30 or C34 and C35 using values appropriate for the crystals you select. Headers J9, J10, J11, and J12 connect the external crystal pins to the general purpose I/O headers (J1 and J2). If the external crystal is in use, these headers should not be populated. Refer to the C8051F52x/52xA/53x/53xA data sheet for more information on the use of external oscillators.

7.3. Switches and LEDs

Four switches are provided on the target board.

Switch RESET_A is connected to the RESET pin of the C8051F530A A-Side (U2).

Switch RESET_B is connected to the RESET pin of the C8051F530A B-Side (U1).

Pressing RESET_A or RESET_B puts the attached device into its hardware-reset state.

Switches P1.4_A and P1.4_B are connected to the C8051F530A parts (U1 and U2) general purpose I/O (GPIO) pins through headers. Pressing P1.4_A or P1.4_B generates a logic low signal on the port pin of the respective microcontroller.

Remove the shorting block from the header to disconnect P1.4_A or P1.4_B from the port pins. The port pin signals are also routed to pins on the J1 and J2 I/O connectors. See Table 1 for the port pins and headers corresponding to each switch.

Four 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 D1 and D2 are connected to the C8051F530A'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 and J2 I/O connectors. The red LED labeled USB ACTIVE is used to indicate that the CP2102 USB-to-UART bridge is properly connected to a PC and is ready for communication. See Table 1 for the port pins and headers corresponding to each LED.

A potentiometer (R32) is provided on the target board. Header J8 connects the potentiometer to +5 V and header J6 connects the potentiometer to the P1.2_A pin of the U2 A-Side C8051F530A microcontroller.

Table 1. Target Board I/O Descriptions

Description	I/O	Header
Reset_A	U2-Reset	none
Reset_B	U1-Reset	none
P1.4_A	U2-P1.4	HDR4[3–4]
P1.4_B	U1-P1.4	HDR3[3–4]
Green LED D2	U2-P1.3	HDR4[1–2]
Green LED D1	U1-P1.3	HDR3[1–2]
Red LED D3	PWR	none
Red LED D4	USB ACTIVE	none
Potentiometer R32	U2-P1.2	J6, J8

7.4. Expansion I/O Connectors (J1, J2)

The two Expansion I/O connectors J1 (26 pins) and J2 (28 pins) provide access to all signal pins of the C8051F530A devices. Pins for V_{DD}, GND, 5 V, Reset, Vbat, LIN, 3.3 V and VREFIN are also available. A small through-hole prototyping area is also provided.

All I/O signals routed to connectors J1 and J2 are also routed to through-hole connection points between J1 and J2 and the prototyping area (see Figure 3 on page 9). Each connection point is labeled indicating the signal available at the connection point. See Table 2 for a list of pin descriptions for J1 and J2.

Table 2. Pin Descriptions for J1 and J2

J1			
Pin #	**Description**	**Pin #**	**Description**
1	P0.0_B	14	P1.5_B
2	P0.1_B	15	P1.6_B
3	P0.2_B	16	P1.7_B
4	P0.3_B	17	+5V
5	P0.4_B	18	RST/C2CLK_B
6	P0.5_B	19	VBAT
7	P0.6_B	20	LIN
8	P0.7_B	21	NC
9	P1.0_B	22	VREGOUT_B
10	P1.1_B	23	NC
11	P1.2_B	24	NC
12	P1.3_B	25	GND
13	P1.4_B	26	GND

J2			
Pin #	**Description**	**Pin #**	**Description**
1	P0.0_A	15	P1.6_A
2	P0.1_A	16	P1.7_A
3	P0.2_A	17	+5V
4	P0.3_A	18	RST/C2CLK_A
5	P0.4_A	19	VBAT
6	P0.5_A	20	LIN
7	P0.6_A	21	VREFIN
8	P0.7_A	22	VREGOUT_A
9	P1.0_A	23	+3.3V
10	P1.1_A	24	NC
11	P1.2_A	25	NC
12	P1.3_A	26	NC
13	P1.4_A	27	GND
14	P1.5_A	28	GND

7.5. Target Board DEBUG Interface (HDR1, HDR2)

The DEBUG connectors (HDR1 and HDR2) provide access to the DEBUG (C2) pins of the C8051F530A parts. They are used to connect 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	$\overline{\text{RST}}$ (Reset)
6	P0.6
7	C2CK
8	Not Connected
10	USB Power

7.6. USB to Serial Connector (P1, HDR4)

A USB-to-Serial bridge interface is provided. A B-type USB connector (P1), a CP2102, and related circuits are provided to facilitate the serial connection between a PC and the U2 A-Side C8051F530A microcontroller on the target board. The RX, TX, CTS, and RTS signals of the UART side of the Bridge (CP2102) may be connected to the microcontroller by installing shorting blocks on HDR4 as shown in Table 4.

Table 4. UART Connections

HDR3	
Connection	**Signals**
5–6	P0.4_A to TX_A
7–8	P0.5_A to RX_A
9–10	P1.1_A to RTS_A
11–12	P1.2_A to CTS_A

The BUS-Powered CP2102 uses the 5 V provided by the USB interface.

7.7. Analog I/O (TB2, J3, J4, J5)

The Analog connector block (TB2) and headers J3, J4, and J5 provide Analog inputs to the C8051F530A (U2) as shown in Table 5. Headers J3, J4, and J5 connect the inputs from the Analog connector to the microcontroller pins.

Table 5. Analog I/O Connections

TB2			
Signal	**Connection**	**I/O**	**Shorting Block**
Vrefin	External Reference Input or Internal Reference Output	P0.0_A	J5
CH1	Analog Input 1	P1.6_A_MC	J3
CH2	Analog Input 1	P1.7_A_MC	J4
GND	Ground	GND	—

7.8. Power Supply Options (P5, TB1, J13, J14)

The target board provides two options of power supply. The first option is to use the provided 9 V power supply attached to the P5 connector. The second option is to use an external 12 V (7.5 V minimum) connected to the TB1 terminal block (pins 1 and 3).

Headers J13 and J14 connect the +5 V power supply to the VREGIN pins on U1 and U2. These headers can be populated to supply power directly or depopulated to measure the operating current drawn by the corresponding C8051F530A device.

7.9. LIN Connectivity (TB1)

The C8051F530A Target Board has two C8051F530A devices (U1 and U2) and two LIN transceivers (T1 and T2) to provide LIN connectivity on the target board. These devices can also be interfaced to another LIN bus using the TB1 terminal block.

Table 6. LIN Connections

TB1	
Signal	**Connection**
+12V	Supplies 12 V (7.5 V minimum) to the target board. This can be connected to the power supply of another LIN bus or any external supply.
LIN	Connects the 12 V LIN bus signal to the T1 and T2 LIN transceivers.
GND	Ground

8. Schematics

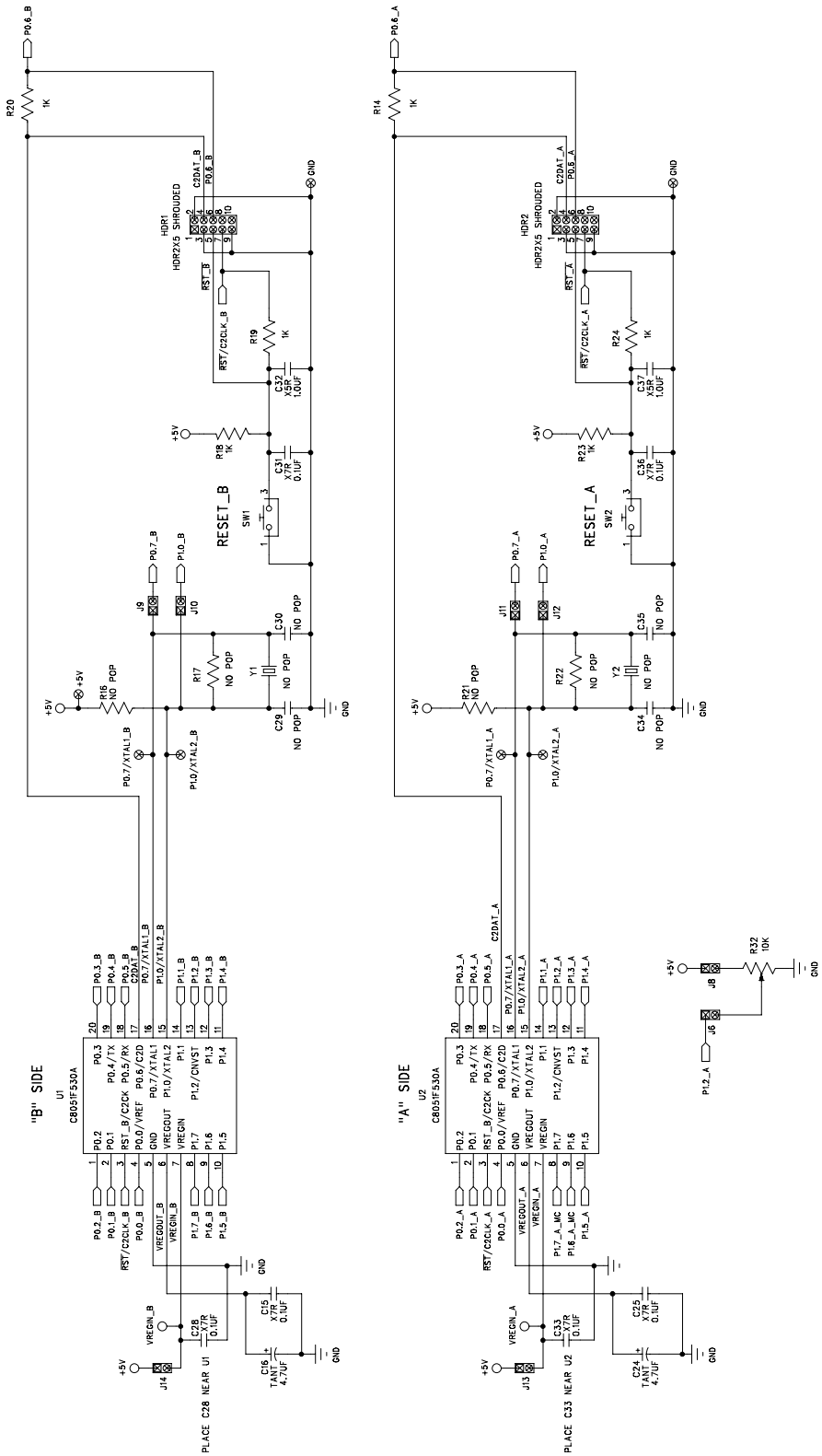

Figure 4. C8051F530A Target Board Schematic (1 of 3)

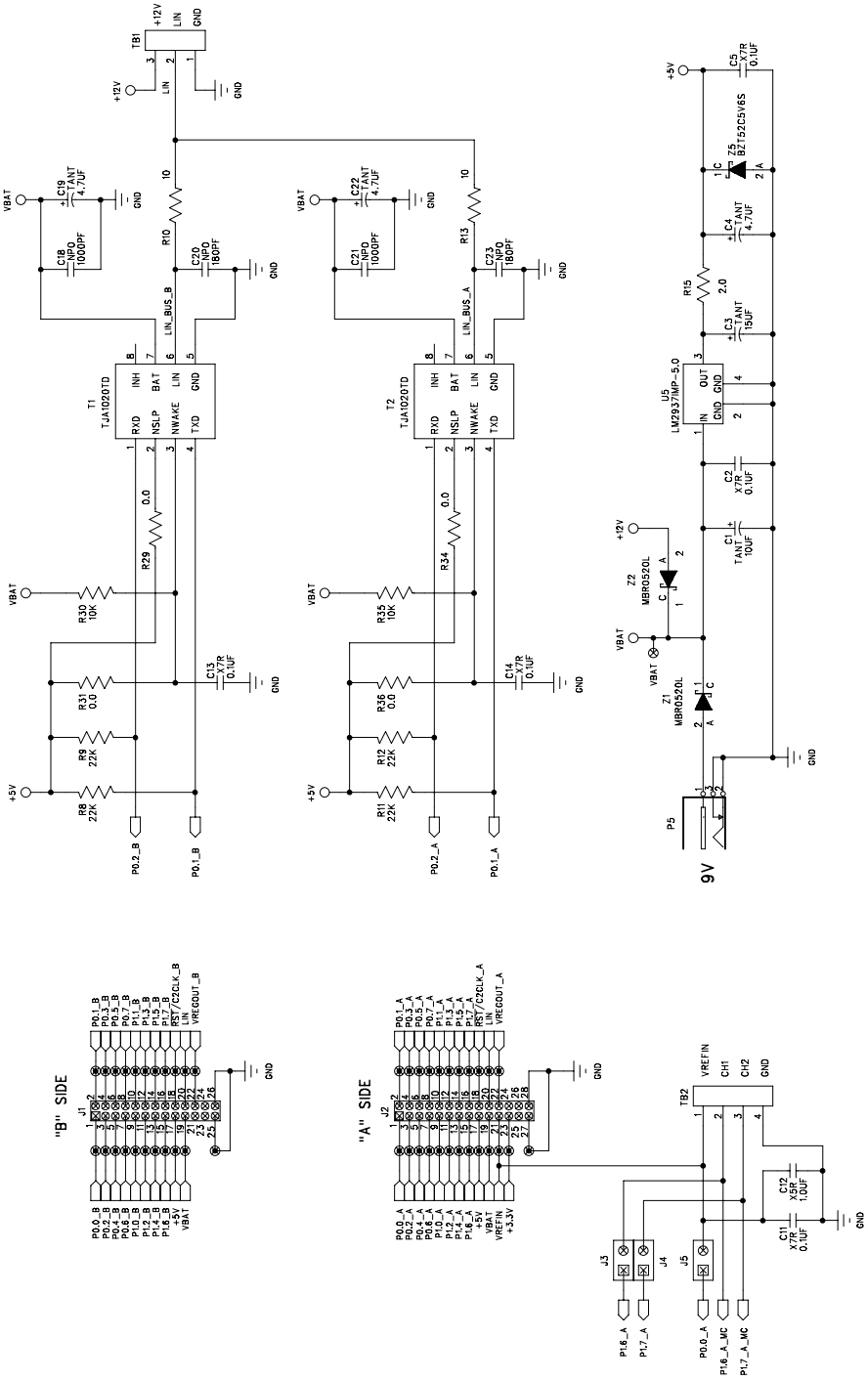

Figure 5. C8051F530A Target Board Schematic (2 of 3)

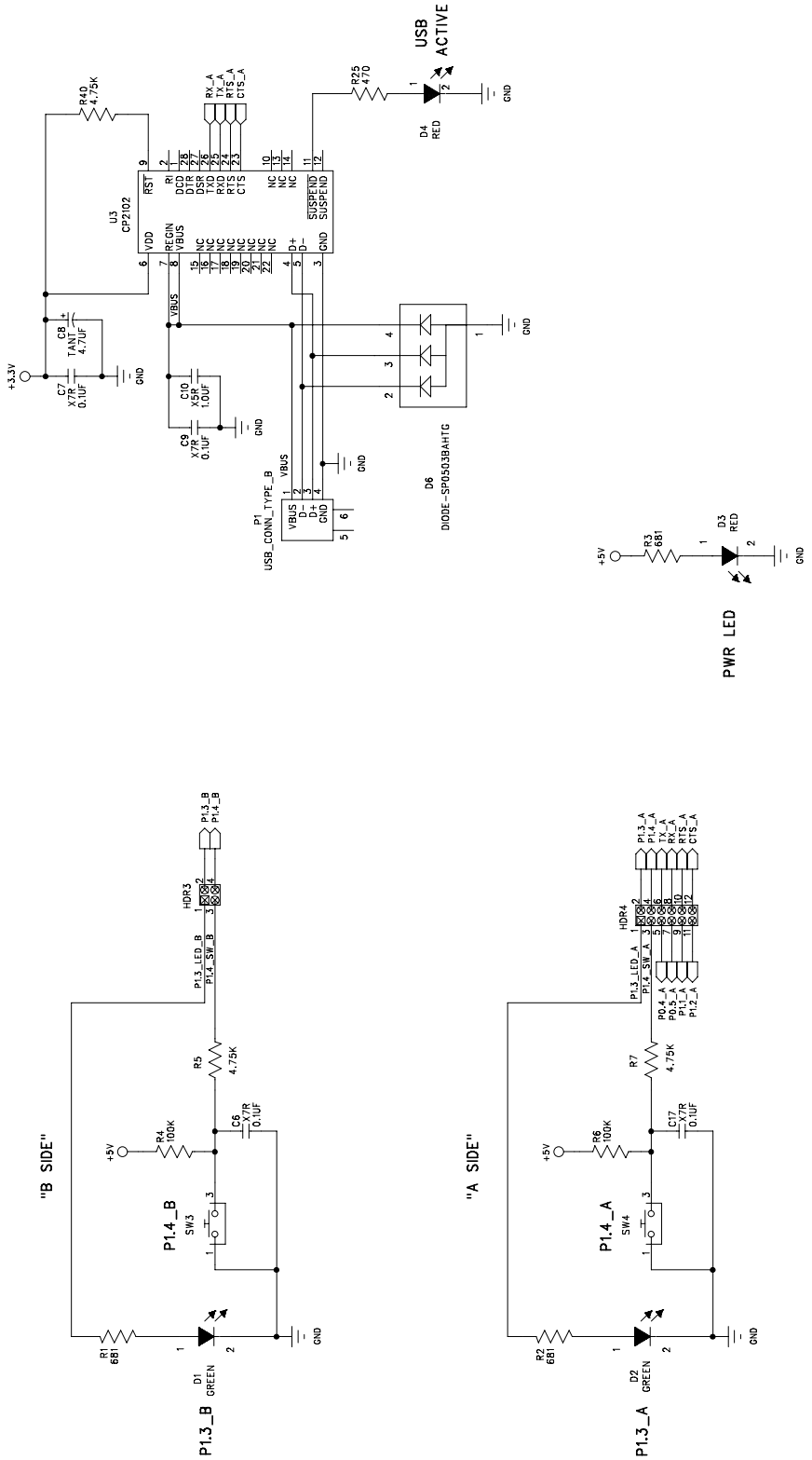

Figure 6. C8051F530A Target Board Schematic (3 of 3)

DOCUMENT CHANGE LIST

Revision 0.2 to Revision 0.3

- Updated for C8051F530A TB.
- Added "LIN Connectivity (TB1)," on page 12.

NOTES:

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