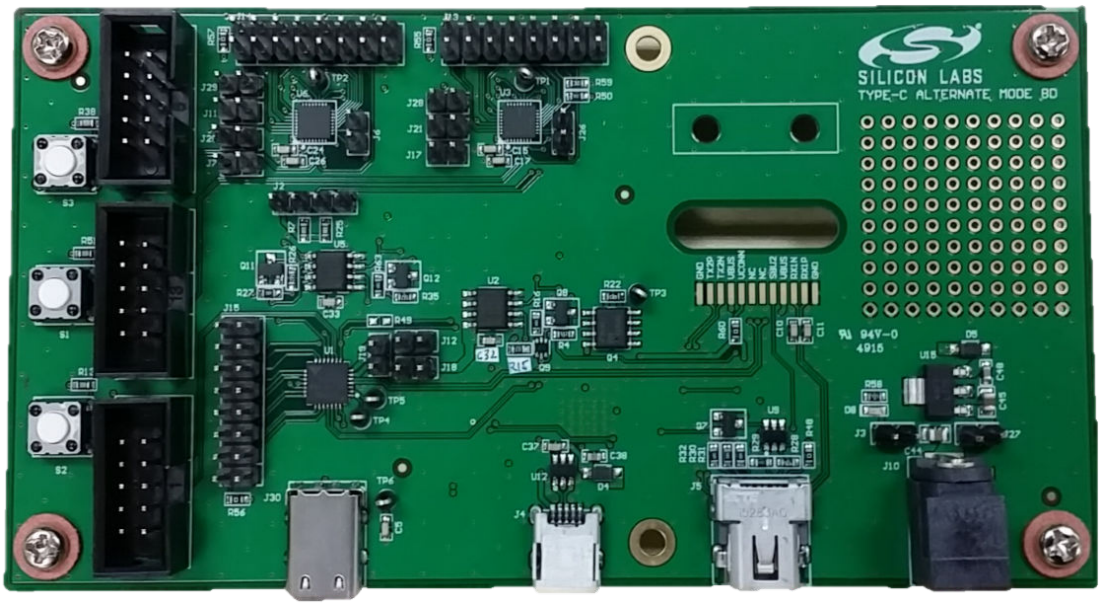
UG233: USB Type-C Reference Design User's Guide

The EFM8 USB Type-C Reference Design is intended to aid the development of various USB Type-C applications and consists of a development board, Simplicity Studio libraries, and example code.

The board contains Power Delivery (PD) controllers, Billboard devices, and Alternate Mode functionality.

KEY POINTS

- Describes the Type-C reference design board
- Explains how to load the software examples and begin evaluation and development
- Discusses the power scenarios/options related to the reference board
- Shows how to configure the Debug Serial Terminal
- Shows the reference design board schematics



1. Introduction and Running the Demo

The USB Type-C Reference Design is intended to aid the development of various USB Type-C applications and consists of a development board, Simplicity Studio libraries, and example code. Out of the box, the board is configured as a DisplayPort alternate mode video adapter. For a quick demo, simply plug the USB Type-C captive cable into a compatible host and a monitor cable into the mini DisplayPort (mDP) receptacle. In the absence of a DisplayPort-capable monitor a video converter dongle, like the white VGA-to-mDP shown in the image, can be used. However, in this case, J22 must be closed in order to power the external adapter.

Figure 1.1. Demo Setup

2. Board Description

The Type-C reference design board is a platform for developing and evaluating hub and dongle Type-C solutions. The board contains Power Delivery (PD) controllers, Billboard devices, and Alternate Mode functionality. The PD Controller is implemented with EFM8 Busy Bee 3 (EFM8BB3) MCU, and takes advantage of the feature-rich peripherals available on-chip. The only necessary external circuits are the CC lines voltage clamps for Dead-Battery, the slew rate control capacitors, and a Pull-Up (Rp) switch for Power Role SWAP function and DRP support. The board also contains a Billboard device implemented with the EFM8 Universal Bee 1 (EFM8UB1) MCU and allows for Alternate Mode to be used and sent through the Type-C port. For debugging and communication purposes, a USB-to-Quad UART Bridge Controller (CP2108) is used to print debug messages from all MCUs to a USB host serial terminal. Most of the available GPIOs from each MCU are routed to pin headers for convenient interfacing with instrumentation and/or system-level integration. The C2 debug interface for each MCU is also routed to headers so that individual firmware can be loaded onto each device.

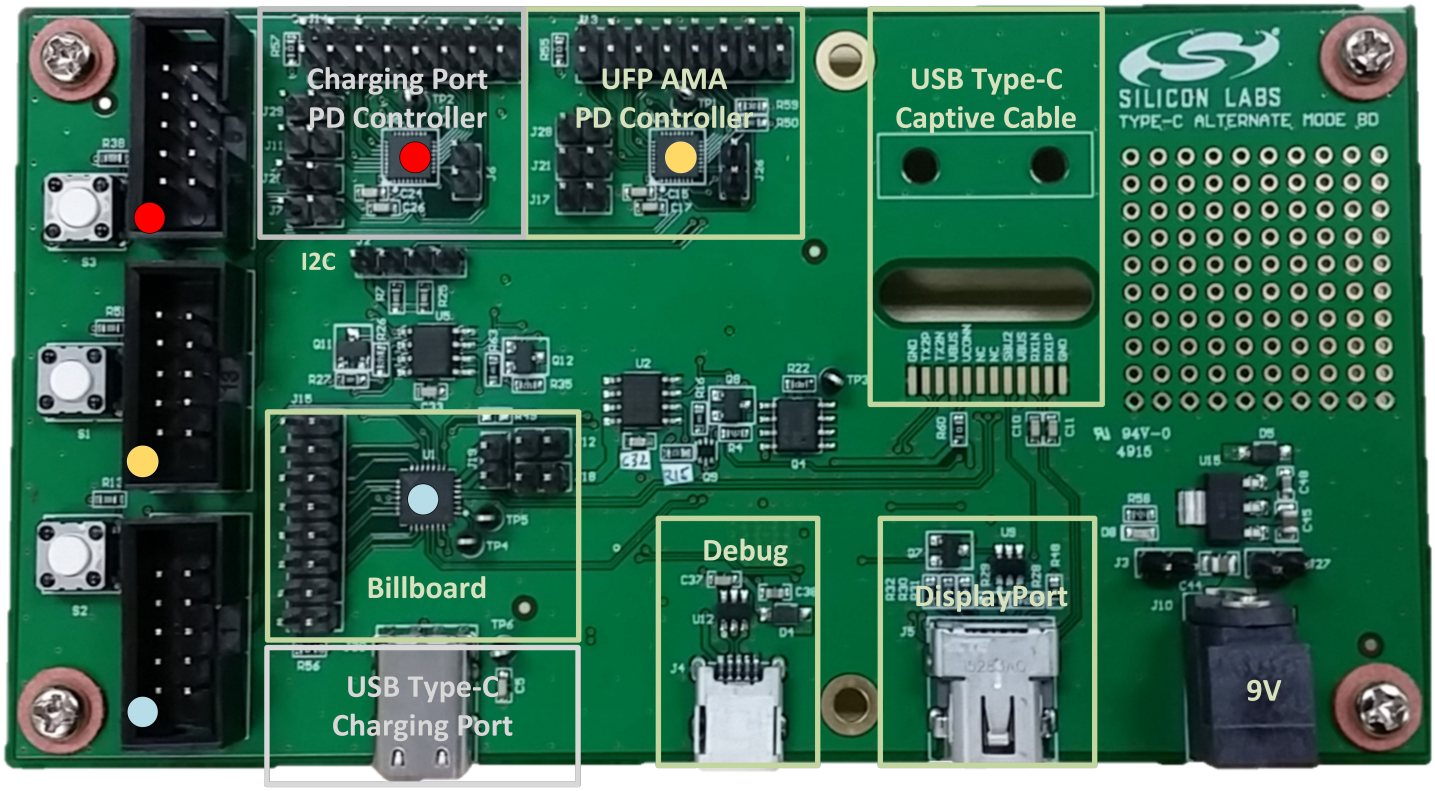


Figure 2.1. Board Layout

Table 2.1. Board Component Map

Component	Name	Function
J26	Jumper	Must be closed for proper operation.
J17	Jumper	Alternate Mode PD controller MCU power supply monitoring jumper. Must be closed for normal operation.
J12	Jumper	Billboard device MCU power supply monitoring jumper. Must be closed for normal operation.
U3	EFM8BB3	USB Type-C DisplayPort Alternate Mode Power Delivery controller.
J8	HEADER_EC3	C2 programming interface connector for U3 MCU.
U1	EFM8UB1	USB Billboard class device.
J1	HEADER_EC3	C2 programming interface connector for U1 MCU.
U6	EFM8BB3	USB Type-C charging port Power Delivery controller.
J3	HEADER_EC3	C2 programming interface connector for U6 MCU.
J5	mDP Socket	Mini DisplayPort socket.
J4	Mini USB	Used for printing debug messages to a serial terminal.
J30	USB Type-C Receptacle	Charging port connector. The socket is rated 3A max.
S1	Switch	Reset push button switch for U3 MCU.
S2	Switch	Reset push button switch for U1 MCU.
S3	Switch	Reset push button switch for U6 MCU.
J2	Pins header	I2C bus.

The following block diagram can be used to understand the main functions of the reference design and the connections between devices and plugs.

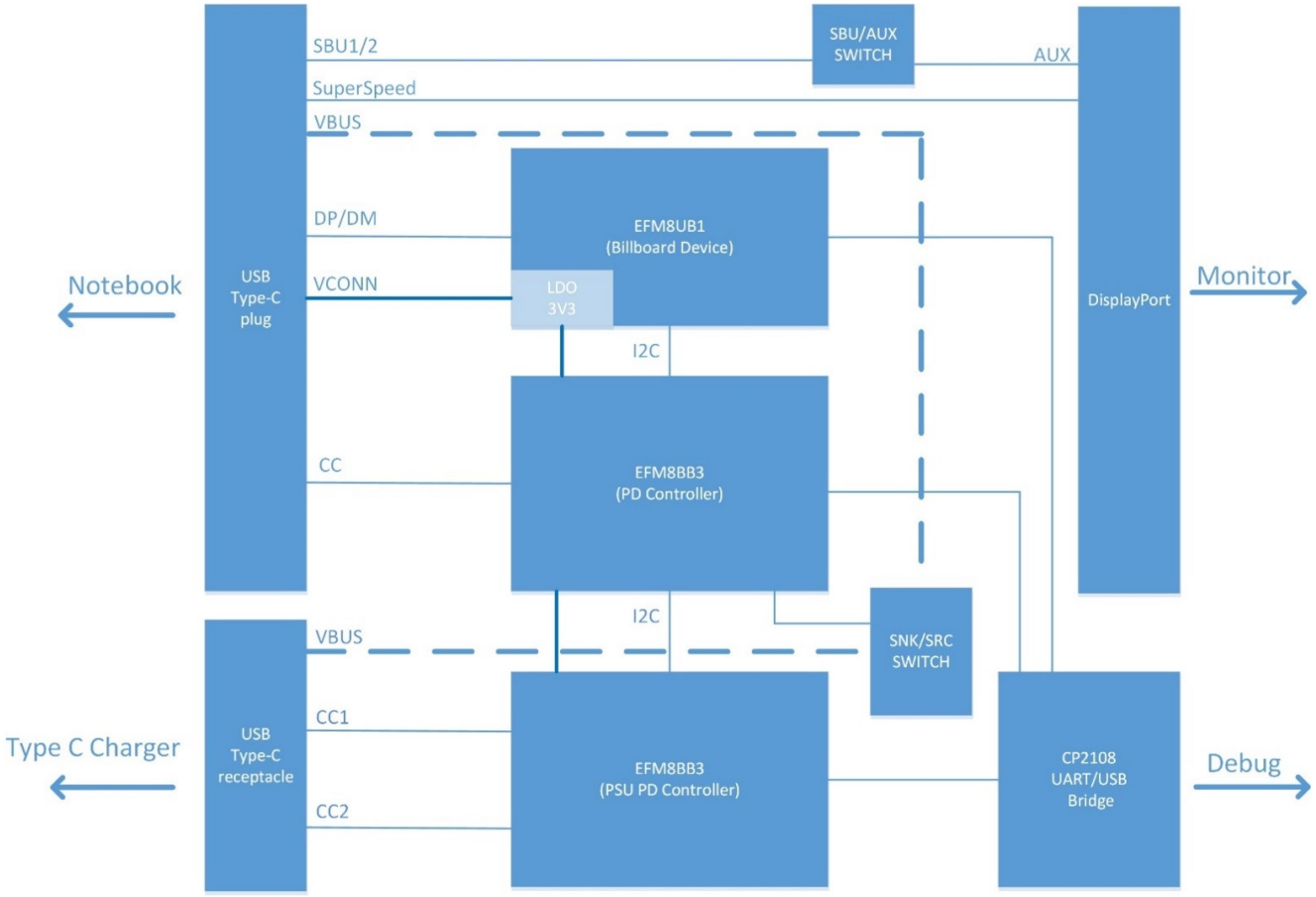


Figure 2.2. Functional Block Diagram Overview

3. Evaluation and Development

The Type-C reference design with all of the above-mentioned capabilities is available for free once a Software License Agreement has been signed. After getting the demo to run, the next step is to load the software examples and source code to begin development.

1. Download and extract the `Release` folder from the provided reference design.

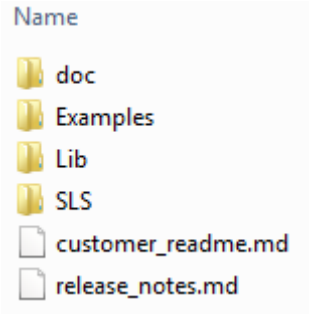


Figure 3.1. Reference Design Folder

2. Download and install Simplicity Studio from http://www.silabs.com/products/mcu/Pages/simplicity-studio.aspx.
3. Open the Simplicity Studio IDE and switch workspaces using the [**File**] → [**Switch Workspace**]. Locate the release folder that was extracted in step one and select the top-level folder as the workspace.
4. Import the project by going to [**File**] → [**Import**] → [**Simplicity Studio**] → [**MCU Project**].
5. Locate the `SLS` directory under the reference design folder and select one of the projects to develop: `ufp_dongle`, `knlexample`, or `billboard`.
6. Ensure that EFM8BB31F64G part is selected and click [**Next**].
7. The project is now imported and can build, run, or be altered to fit specific needs.

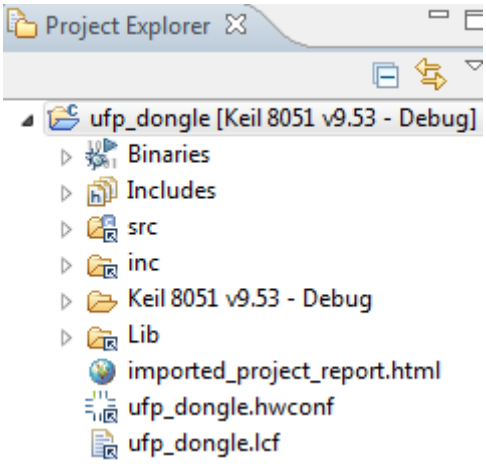


Figure 3.2. UFP Dongle Project

8. For development assistance and information on the programming interface please open [**index.html**] in the [**doc**] directory.

Each of the UC3 headers on the board connects the C2 interface of a specific device. The color-coded circles in the Figure 2.1 Board Layout on page 3 show which header connects to which device. By using a debug adapter like this https://www.silabs.com/products/mcu/Pages/USBDebug.aspx, the firmware developed in Simplicity Studio can be loaded onto the devices.

4. Power

For developers' convenience, the reference board supports a flexible powering scheme, as depicted in the following diagram:

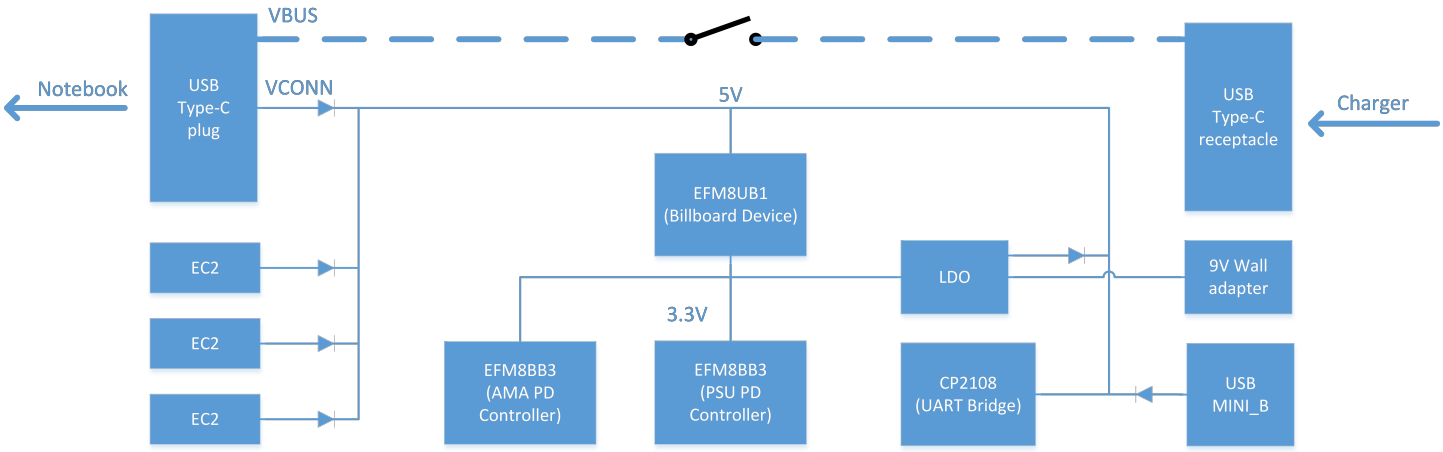


Figure 4.1. Power Block Diagram

Various power sources can co-exist due to the presence of separate diodes. Below are some power scenarios:

1. VCONN provides power from the USB-C host (DFP). No other power sources are needed for the functional mode.

   Note: If a VGA to mDP dongle is used, VCONN alone may not be able to supply enough power.
2. EC3 debug adapter provides power while flashing/debugging the MCU in Simplicity Studio.
3. The board can be powered from the USB host which runs the Serial Terminal Application.
4. Standard 9 V wall adapter.

The 3.3 V voltage can be obtained from an external LDO (Max. 500 mA), or from the EFM8UB1 internal LDO (Max. 100 mA). The following jumper settings are for evaluating different configurations:

1. External 5 V/3.3 V LDO and EFM8UB1 powered from 5 V: J3 – short, J12 – short, J19 – open, J18 – open
2. External 5 V/3.3 V LDO and EFM8UB1 powered from 3.3 V: J3 – short, J12 – open, J19 – short, J18 – short
3. EFM8UB1 5 V/3.3 V internal LDO: J3 – open, J12 – short, J19 – open, J18 – short

5. Debug Serial Terminal Configuration

1. Install the appropriate CP2108 (USB to Quad UART Bridge Controller) driver for your OS.
2. When connecting the development board for the first time, it may take a while until the USB host enumerates the device. Check the driver installation message and/or the Device Manager for completion.

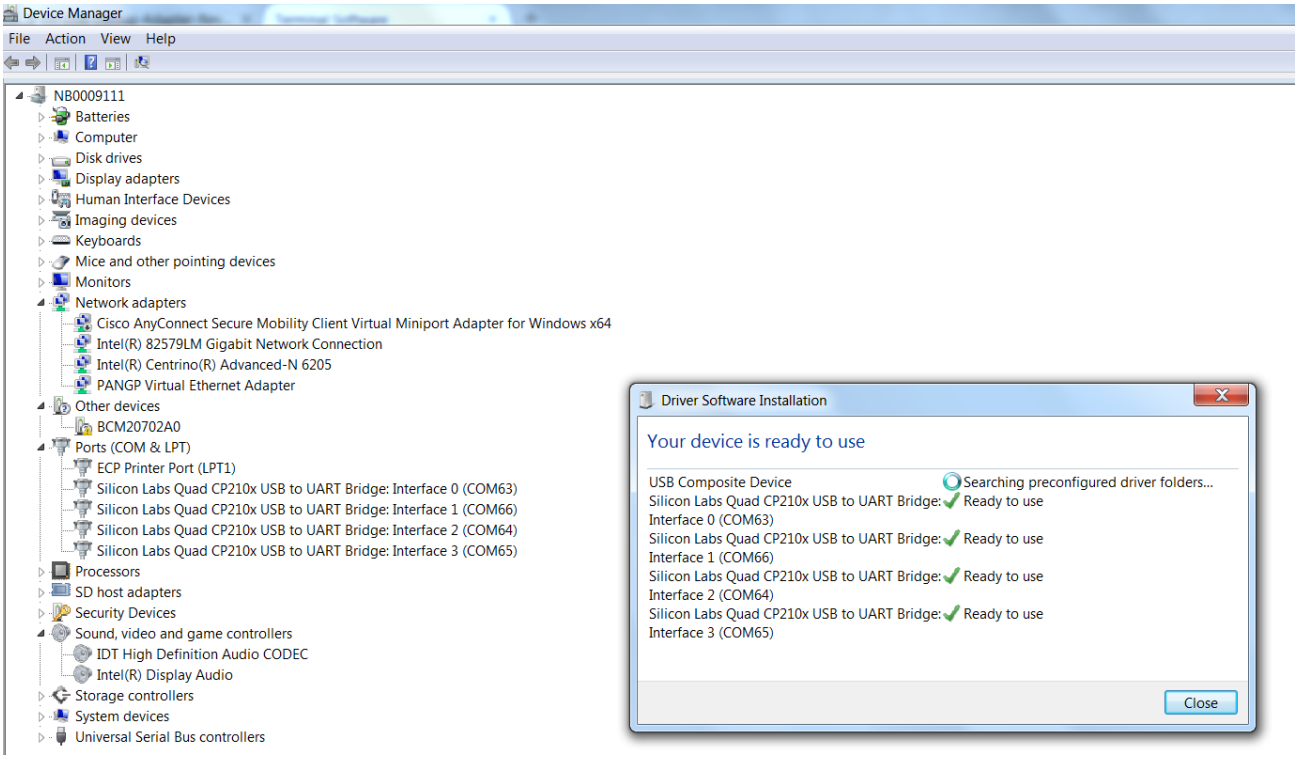


Figure 5.1. Bridge Driver Installation

3. Install a Serial Terminal Application (Ex: Realterm).
4. After the successful USB device enumeration, open the terminal window and connect to the desired port with the following settings:

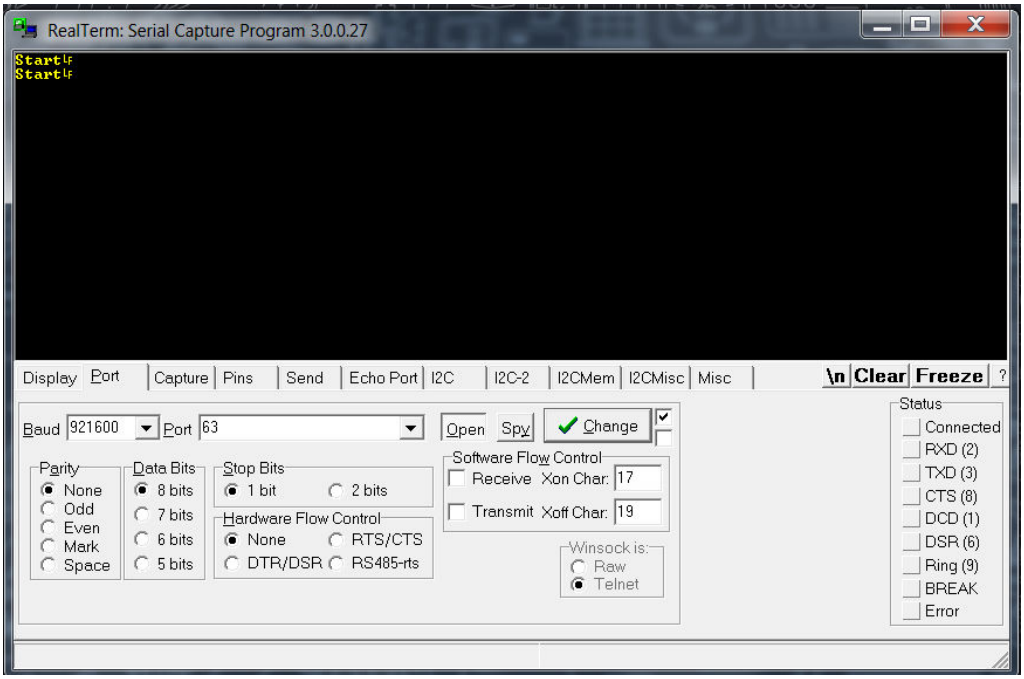


Figure 5.2. Debug Connection

6. Schematics

The schematics for the reference design board are shown below. These are also available within the reference design folder.

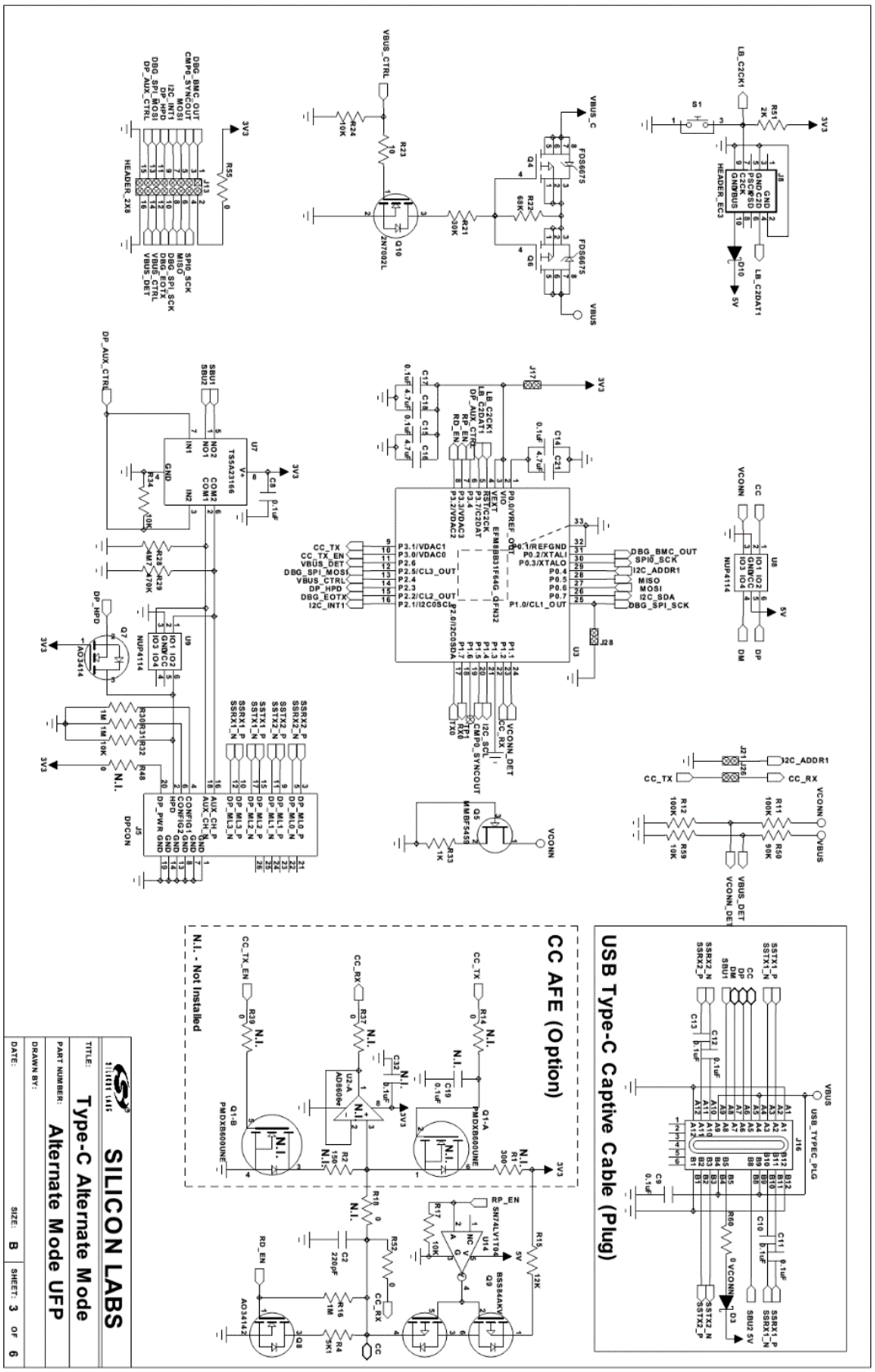


Figure 6.1. Alternate Mode UFP

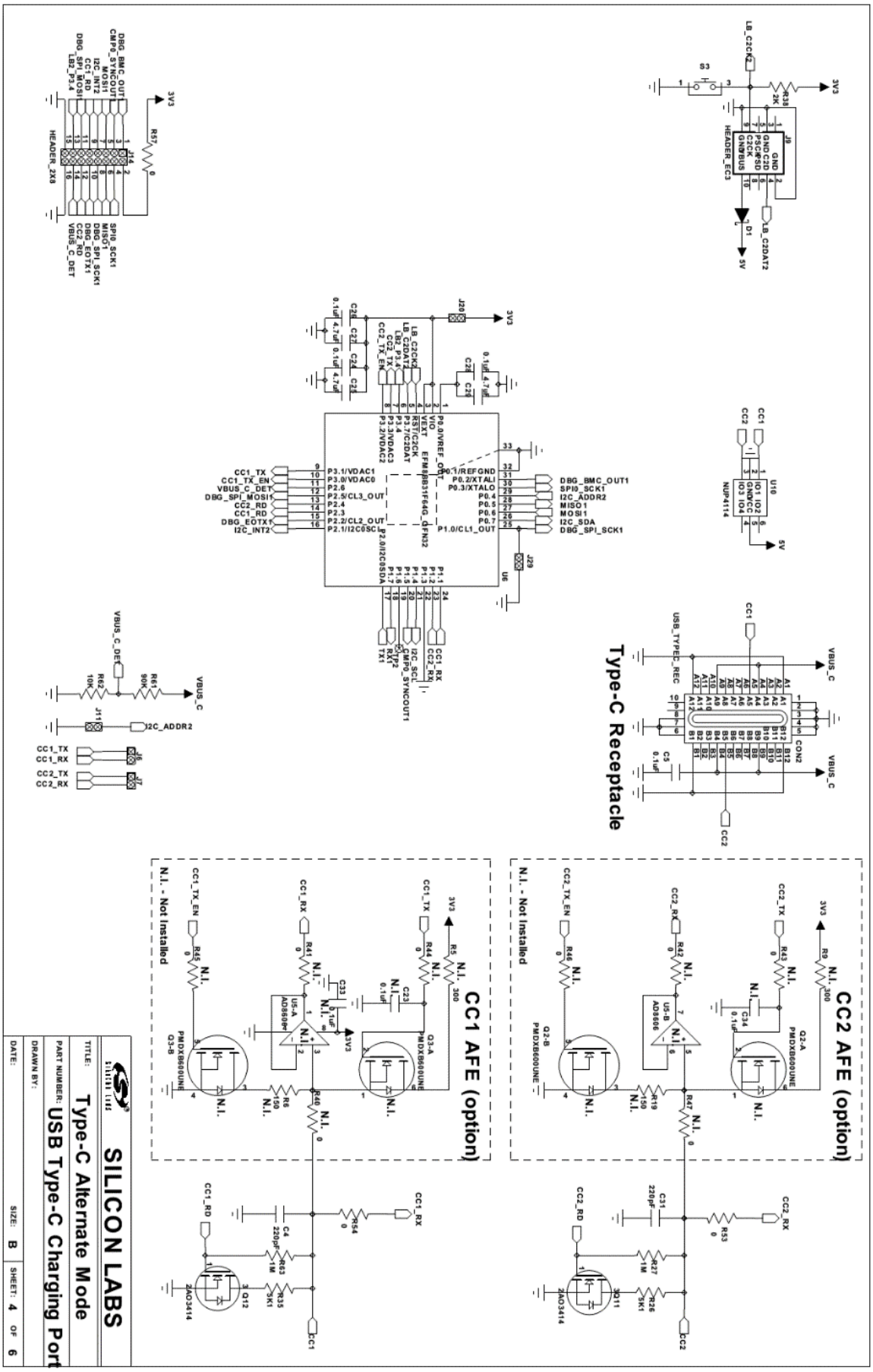


Figure 6.2. USB Type-C Charging Port

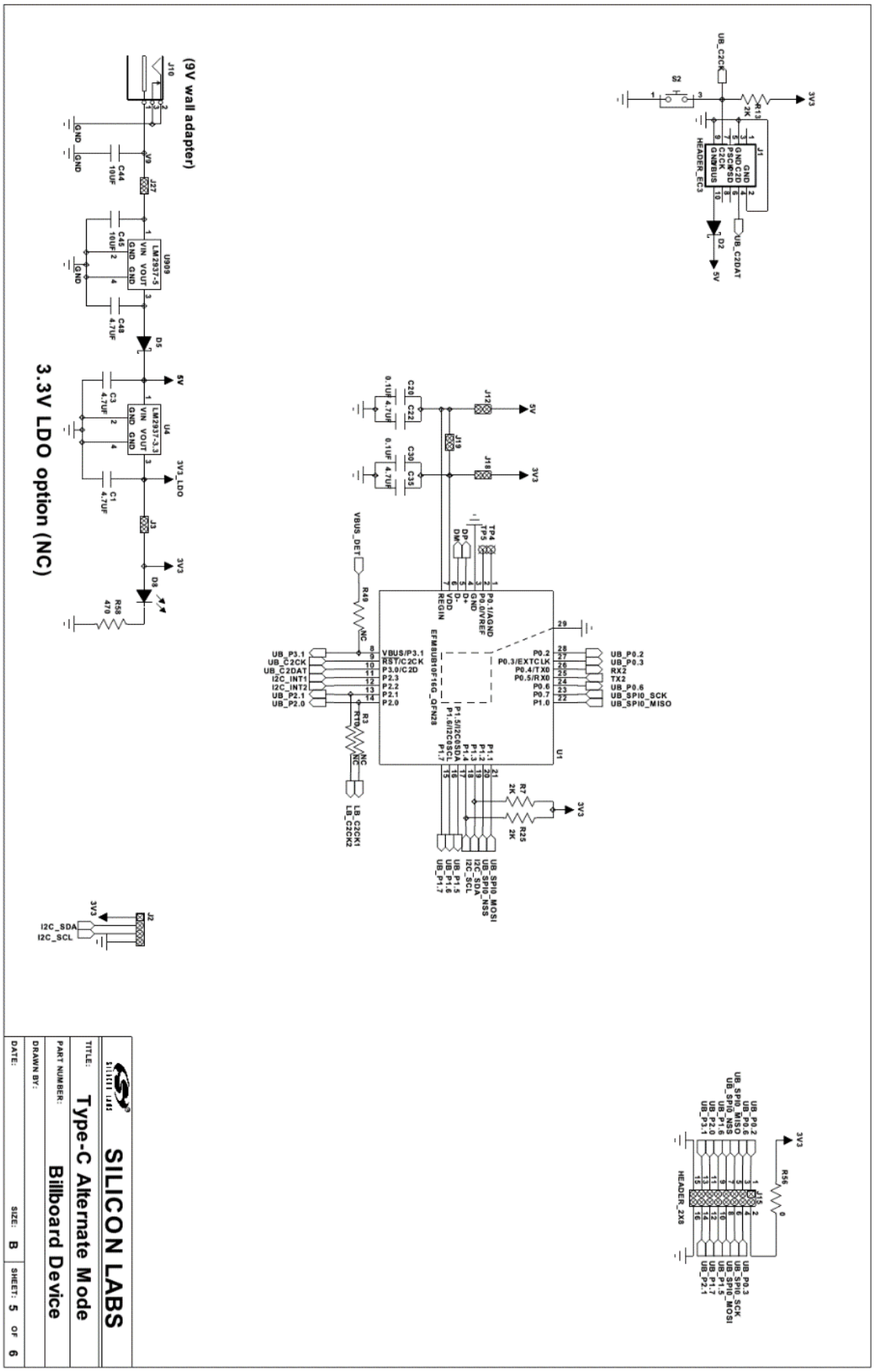


Figure 6.3. Billboard Device

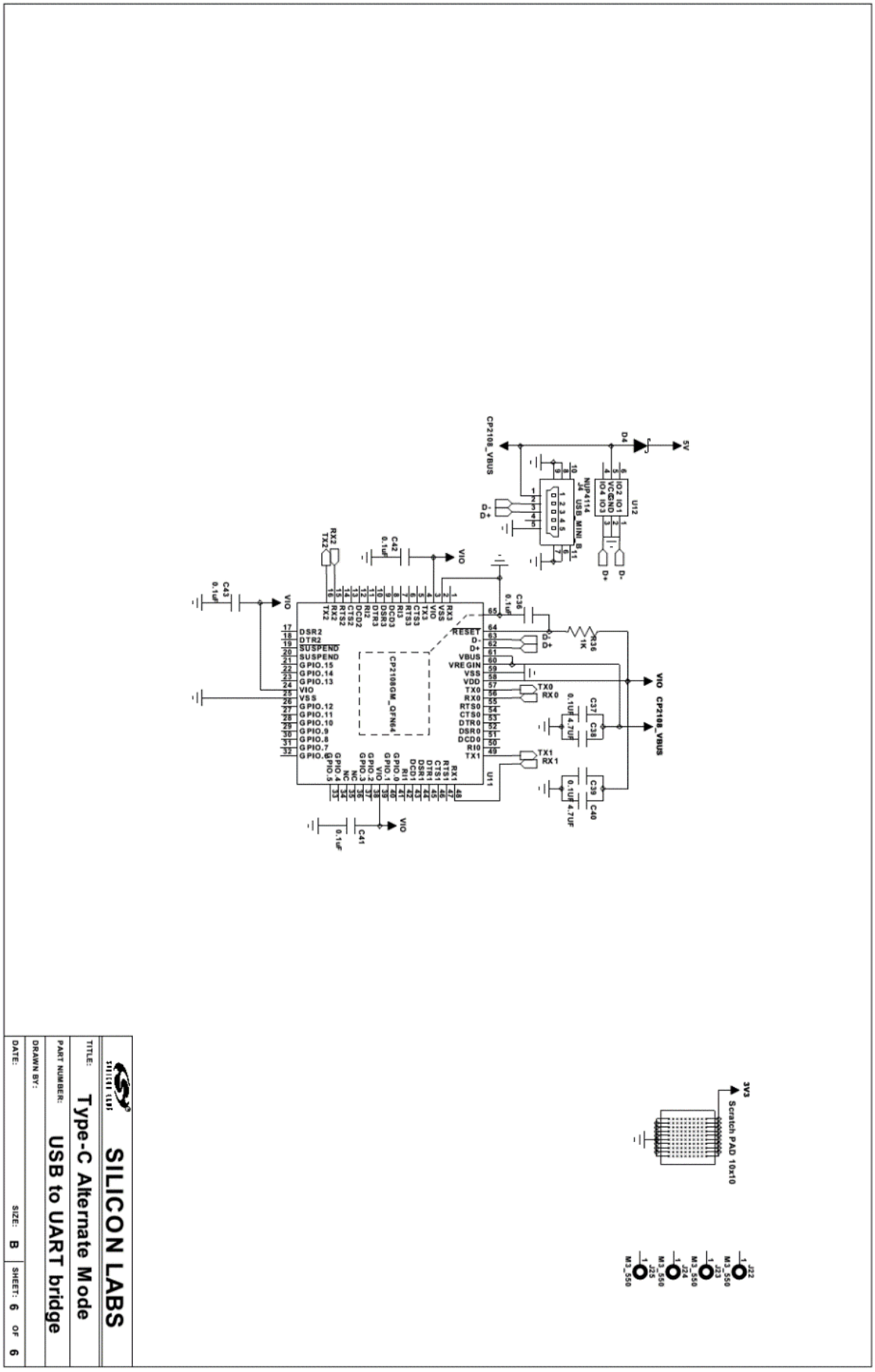
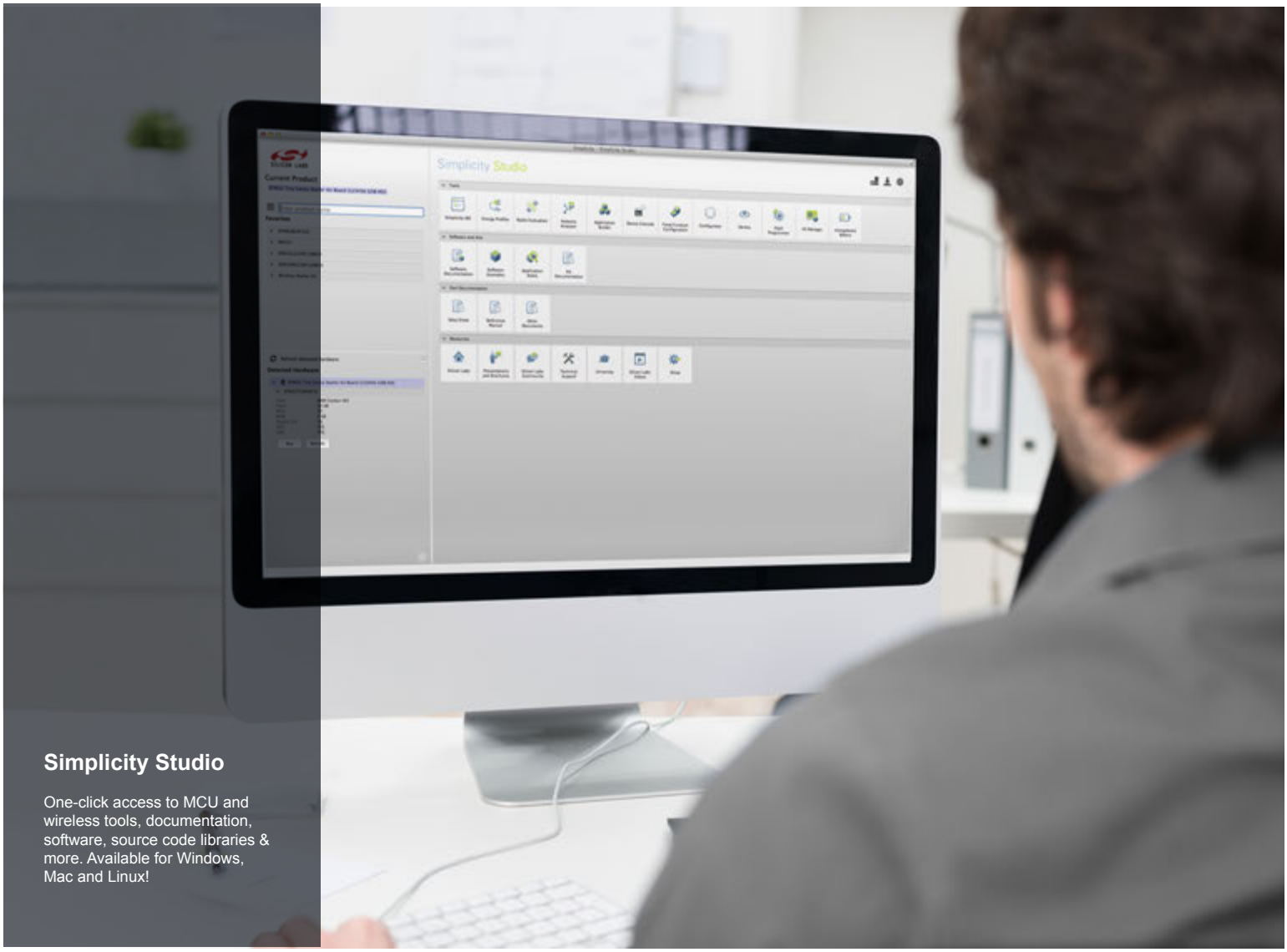


Figure 6.4. USB to UART Bridge



Simplicity Studio

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