QUICKSENSE™ FRONT PANEL USER'S GUIDE

1. Board Functionality

The QuickSense Front Panel Front Panel Demo board has the following demo capabilities:

- Pressing 1 of the 4 capacitive sensing pads lights up that pad's corresponding red LED
- One capacitive sensing pad dedicated to proximity detection measures closeness of a hand's presence
- An Si1120 configured to sense infrared proximity
- Two blue LEDs that turn on when either the capacitive proximity pad or the Si1120 detect a hand's presence
- Capacitance output codes output through UART can be displayed and controlled using QuickSense Studio's Performance Analysis tool

The installation package containing for the QuickSense Front Panel demo board can be downloaded from: http://www.silabs.com/FrontPanel.

2. Hardware Description and Setup

Figure 1 shows the QuickSense Front Panel board. The board consists of the following components:

- C8051F800 MCU
- Si1120 proximity/ambient light sensor
- 4 capacitive sensing pads
- 1 capacitive sensing pad for proximity detection
- 4 red LEDs arranged in a pattern corresponding to each of the four capacitive sensing buttons
- Two blue LEDs used to output detected capacitive or infrared proximity
- Toolstick Base adapter MCU and debug circuit, which debugs and powers the C8051F800
- Power connector (accepts input from 7-15V unregulated power adapter)

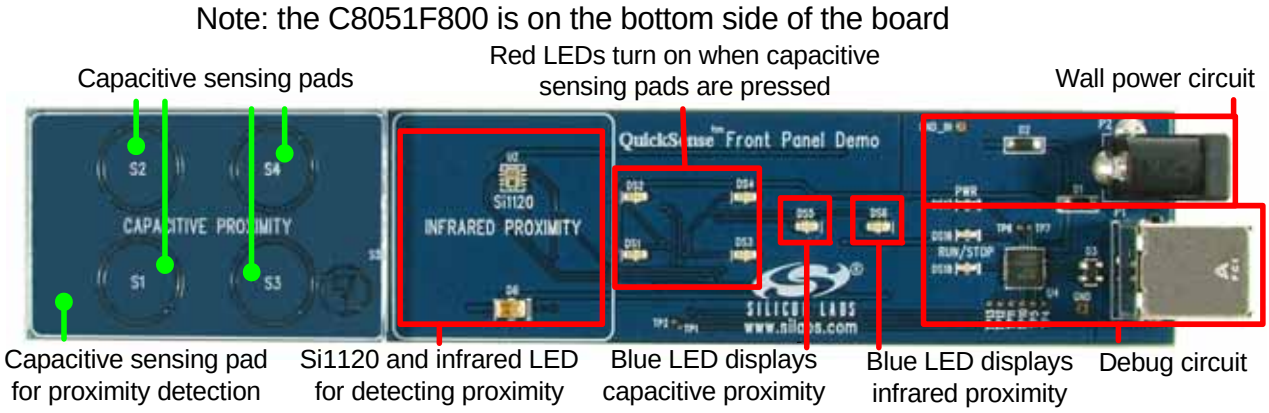

Figure 1. QuickSense Front Panel Board

In order to use the board, follow these steps:

1. Connect a USB cable to the P1 USB connector on the board.
2. Wait for USB enumeration with the board's debug interface to complete.
3. After enumeration, the power LED labeled PWR should be on. At this point, the board is fully functional.
4. The firmware can be reset, forcing an automatic, runtime calibration, by pressing the mechanical switch.
5. Note: instead of powering the board using the USB connector as described in steps 1 and 2, a power adapter can be connected to the P2 power connector.

3. PC Software Overview

3.1. QuickSense™ Studio

The QuickSense Studio software facilitates rapid code development and analysis for applications using the Silicon Labs family of QuickSense products. The Studio is comprised of multiple programs that guide users through an intuitive development flow, including graphical configuration wizards, firmware templates, and performance monitoring tools. These programs interface with the QuickSense Firmware API, a highly configurable open-source firmware library that provides support for many different applications, from simple buttons to complex algorithms like gesture recognition.

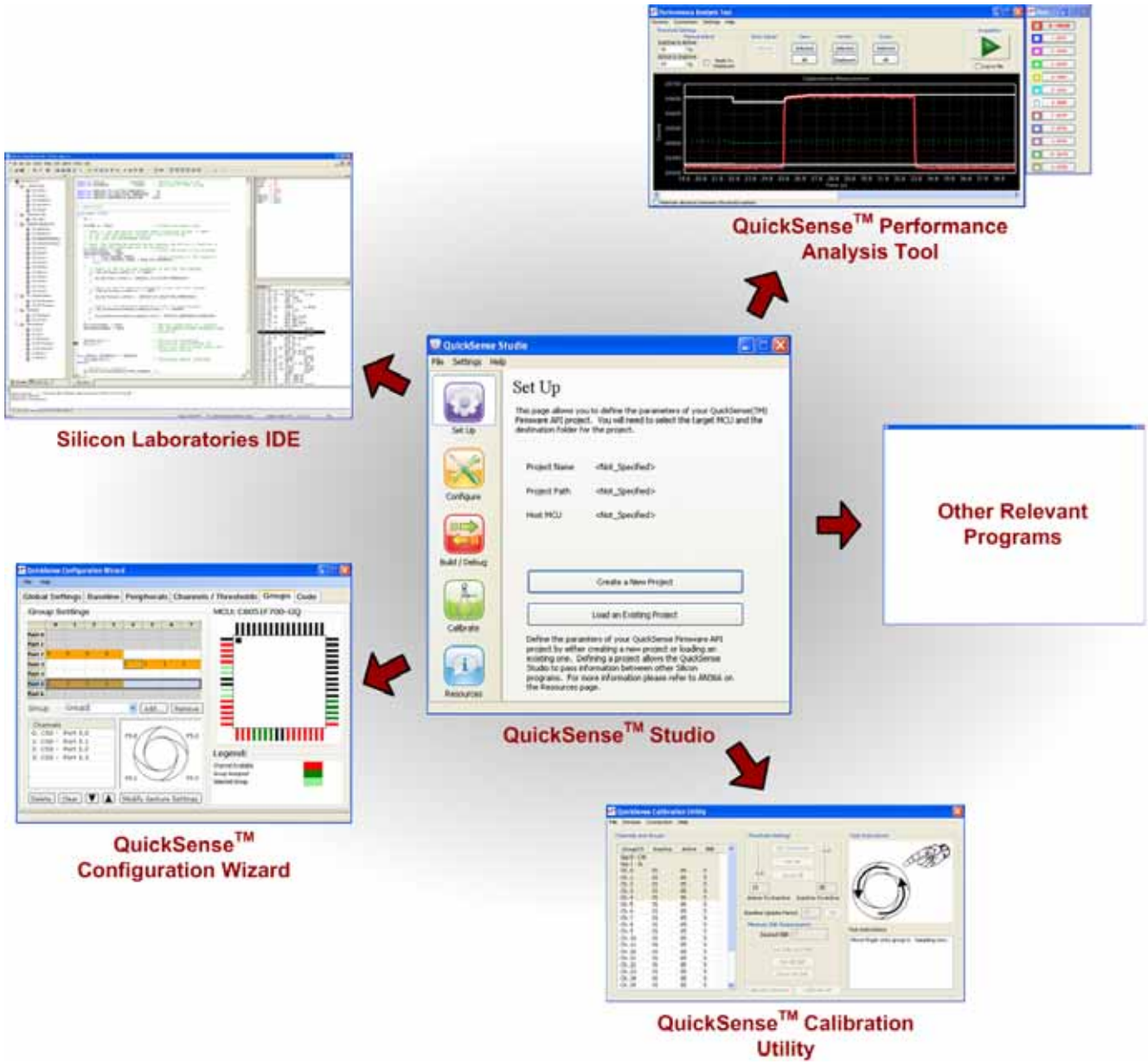

Figure 2. Silicon Labs QuickSense Studio Software

For detailed information on the QuickSense Studio software, please see the QuickSense Studio User's Guide available on the Silicon Labs QuickSense web page (www.silabs.com/quicksense) in the QuickSense Studio section.

3.2. Silicon Laboratories IDE

The Silicon Laboratories IDE integrates a source-code editor, a source-level debugger, and an in-system Flash programmer. 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.

3.2.1. IDE System Requirements

The Silicon Laboratories IDE requirements:

- Pentium-class host PC running Microsoft Windows 2000 or newer.
- One available USB port.

3.2.2. Third Party Toolsets

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

- Keil
- IAR
- Raisonance
- Tasking
- SDCC

For a more detailed description of the QuickSense Firmware API or the Serial Interface, see “AN366: QuickSense API.” For a more detailed description of active/inactive thresholds, see “AN367: Understanding Capacitive Sensing Signal to Noise Ratios.” For a discussion on baselining in the QuickSense Firmware API, see “AN418: Baselining in the QuickSense Firmware API.

3.3. Demo Information

The QuickSense Front Panel board can be used to highlight many different features of the C8051F800. Follow the process outlined in “2. Hardware Description and Setup” to provide power to the board.

Note: If the board is being powered through the PC’s USB interface, the PC does not need to run any software in order for the user to demonstrate the board’s capabilities.

- Once the board has been powered, holding a hand 1 to 3 inches from the board above either the area labeled ‘CAPACITIVE PROXIMITY’ or ‘INFRARED PROXIMITY’ will cause the blue LEDs to light up. This demonstrates the board’s capacitive and infrared proximity.
- Pressing the capacitive sensing pads will cause the corresponding red LEDs to turn on. Pressing each pad demonstrates the device’s ability to determine active button states for pads of different sizes and shapes.
- Tapping a capacitive sensing pad lightly or quickly demonstrates the MCU’s high level of capacitance measurement sensitivity and the MCU’s high conversion speed.
- All of the demonstrations above highlight the sensitivity of the C8051F800 through a 1/8 inch overlay.

3.4. Demoing with the Performance Analysis Tool

The QuickSense Front Panel board is compatible with the Performance Analysis tool, which is included with the QuickSense Studio. The QuickSense Studio package can be downloaded from the software downloads page at www.silabs.com.

Running the Performance Analysis tool enables the user to demonstrate the board’s sensitivity with a graphical display. To use the program for a demo, follow these instructions:

1. With the QuickSense Front Panel board and base adapter connected to the PC’s USB port, run QuickSense Studio’s Performance Analysis tool.
2. Click “Devices” and select the Toolstick base adapter (the item on the pulldown list that begins “TS”).
3. Click “Connection” and click “Connect” from the pull-down menu. Once connected, the Performance Analysis tool will draw another window listing all capacitive sensing channels on the board. Because this board has 4 capacitive sensing pads, 1 capacitive proximity detect pad, and a pad for the Si1120’s infrared measurements, the new window lists a total of 6 channels.
4. Increase the update rate to display more capacitive sensing information on the graph by clicking Settings.
5. Add one or more channels to the graph at the bottom of the screen by checking the boxes next to the channels

in the channel list. Note that the first 5channels represent the capacitive sensing pads and the sixth channel represents the infrared detection measurements being made by the Si1120. Figure 3 shows QuickSense Studio's Performance Analysis tool with a list of channels and how each channel maps to the board's sensor pads.

6. Press "Start Acquisition" to be begin receiving and graphing capacitive sensing output codes and infrared measurements from the Si1120.

Figure 3. Performance Analysis Tool with Port Pin Mapping

7. A channel's active and inactive thresholds can be adjusted to increase or decrease a sensing pad's sensitivity or IR sensitivity. Figure 4 shows the steps involved in updating a channel's thresholds.

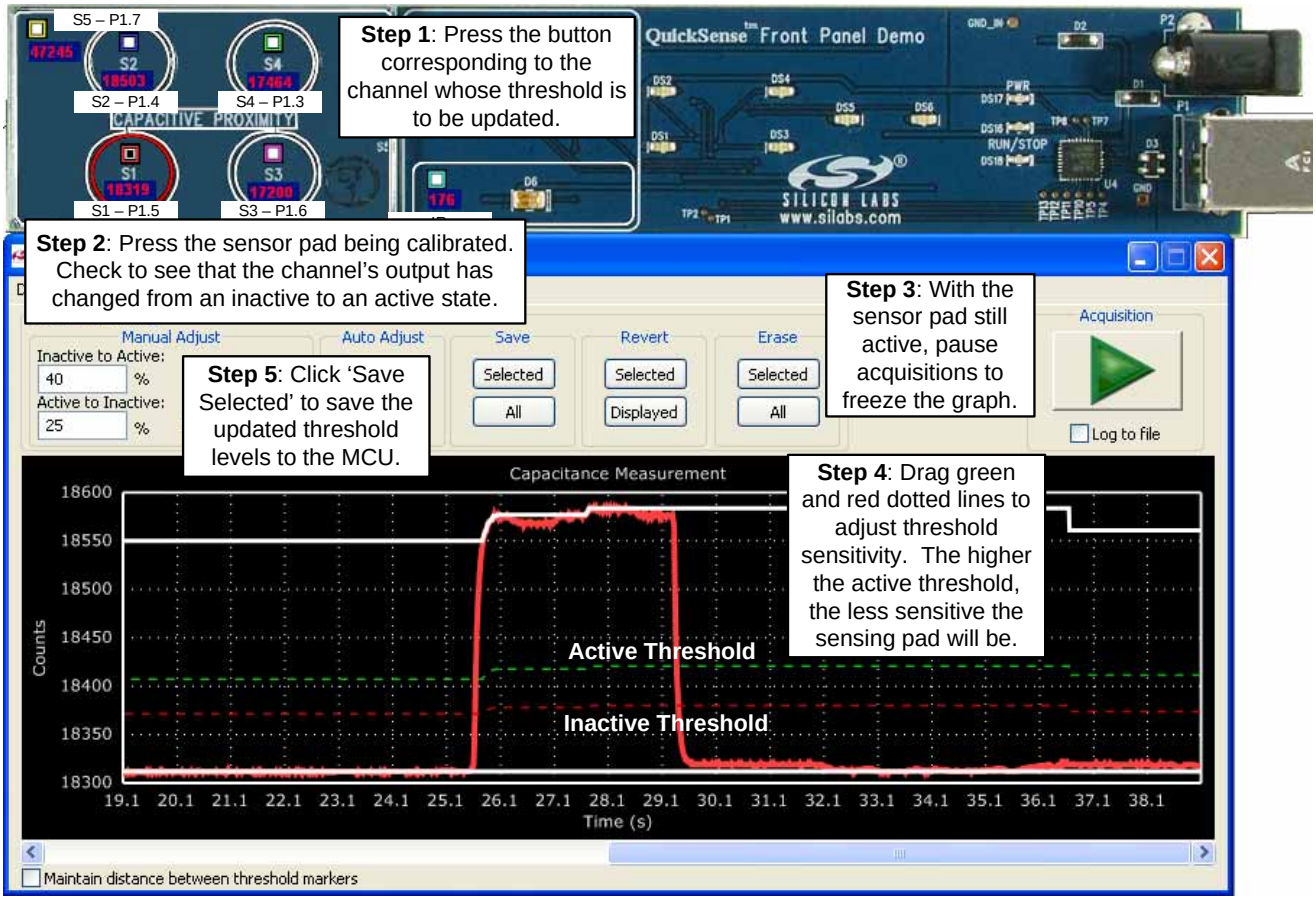

Figure 4. Channel Threshold Update Process

4. Firmware Description

After QuickSense Studio installation, the demo firmware can be found at: c:\Silabs\MCU\QuickSense_Studio\Kits\QuickSense_FrontPanelSTB. The firmware uses the QuickSense Firmware API to measure capacitance on the sensing pads. The firmware API also communicates with the Si1120 to measure infrared proximity. Application layer code turns on or off the board's LEDs whenever a pad is pressed and when close capacitive or infrared proximity is detected. The firmware provides the following functionality:

- Stores measured capacitance values from 4 sensor pads and 1 pad for proximity detection.
- Compares measured capacitance values against calibrated thresholds to determine if buttons have been pressed.
- If a capacitive sensing pad's "active" or "inactive" threshold has been crossed, the API signals an application layer routine to update the red LED array.
- When the capacitive proximity detection pad S5 measures a change in capacitance that crosses its configured "active" threshold, firmware turns on blue LED D5.
- When the Si1120's measured infrared proximity crosses its configured "active" threshold, firmware turns on blue LED D6.
- Using the Human Interface Serial Interface (HISI) protocol, the QuickSense Firmware API transmits measured capacitance values across the UART serial interface to QuickSense Studio's Performance Analysis tool.
- Baselining algorithm reduces effects of environmental changes such as temperature and humidity on sensing pad sensitivity.

Figure 5 shows the mapping of QuickSense Front Panel sensor pads to QuickSense Firmware API project input channels.

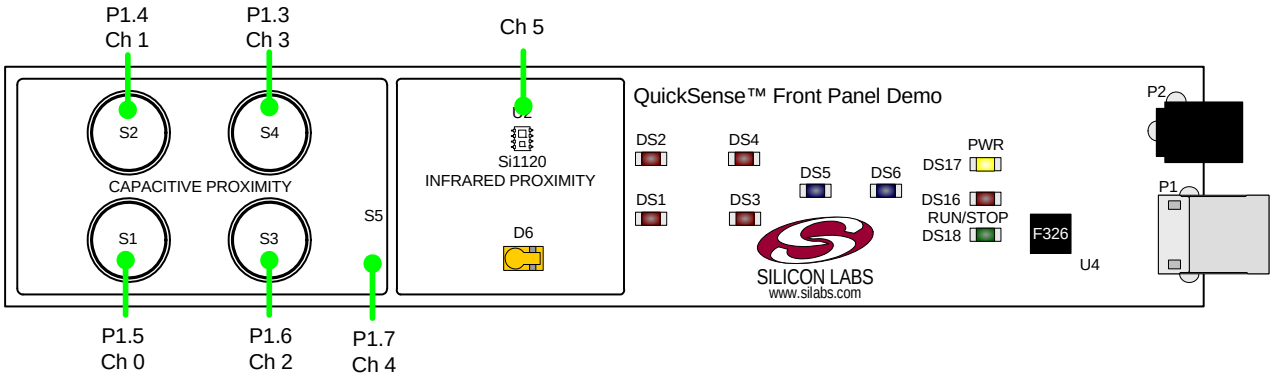

Figure 5. Mapping of Capacitive Sensing Pads and IR to Port Pins and Firmware Input Channels

For a more detailed description of the QuickSense Firmware API or the Human Interface Serial Interface, see "AN366: QuickSense API." For a more detailed description of active/inactive thresholds, see "AN367: Understanding Capacitive Sensing Signal to Noise Ratios." For a discussion on baselining in the QuickSense Firmware API, see "AN418: Baselining in the QuickSense Firmware API."

4.1. Proximity Detection

The current firmware implementation detects proximity through two configurable thresholds. Channel 4's threshold controls the capacitance that must be measured by S5 in order to detect the presence of a hand or other conductive object. Channel 5's active threshold controls the duty cycle measured on the Si1120's PRX pin after firmware initiates an infrared capture process.

A future revision of the firmware will use an application-layer algorithm that will brighten or dim the D5 and D6 LEDs as capacitive and infrared proximity change, respectively.

5. Schematic

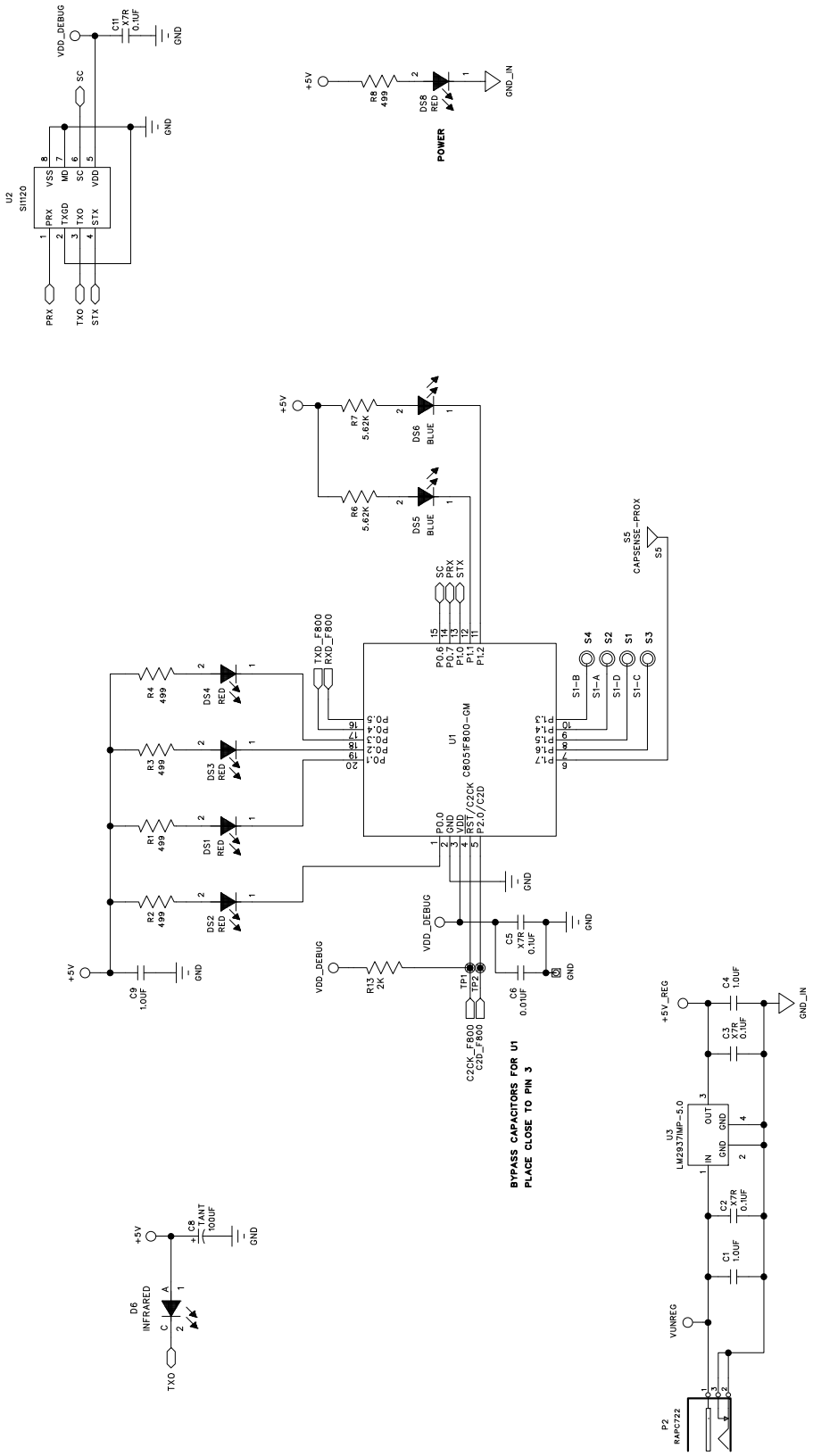

Figure 6. QuickSense Front Panel Schematic (1 of 2)

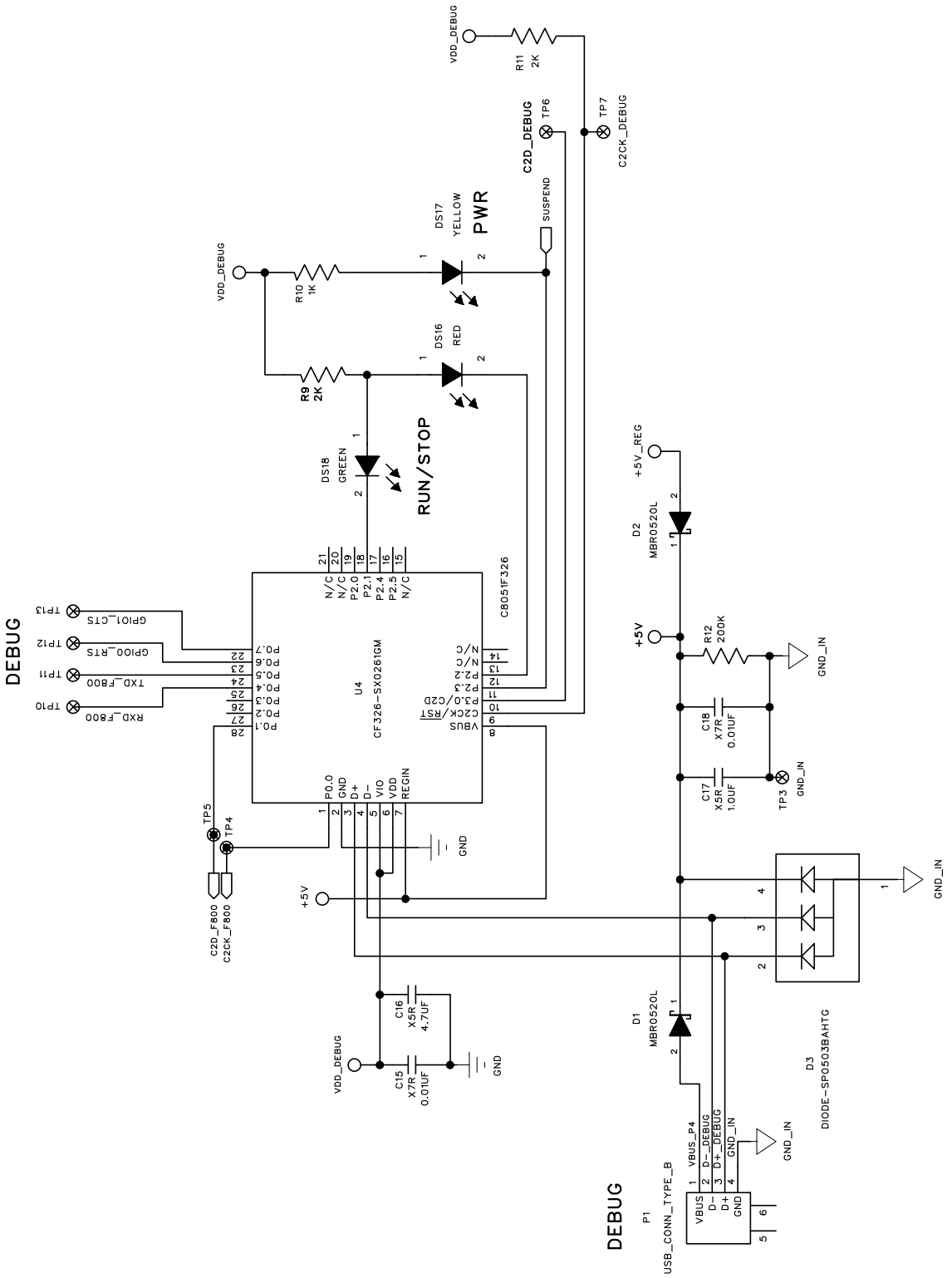

Figure 7. QuickSense Front Panel Schematic (2 of 2)

NOTES:

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