IQS323 User Guide

The user guide introduces the development tools available for the product and guides the setup of certain key elements.

Contents

1 Introduction

This document provides an overview of the IQS323 ProxFusion® device, the graphical user interface (GUI), and the IQS323 evaluation (EV) kits. It aims to equip users with the knowledge needed for configuring, debugging, data logging, and header file export using the GUI software to address their unique applications.

The IQS323EV01 is a general-purpose stamp module that can be used for rapid prototyping and development. It can be connected to external sensing electrodes, allowing the user to experiment with their own sensor designs. See the IQS323EV01 reference schematic in Section 5.1

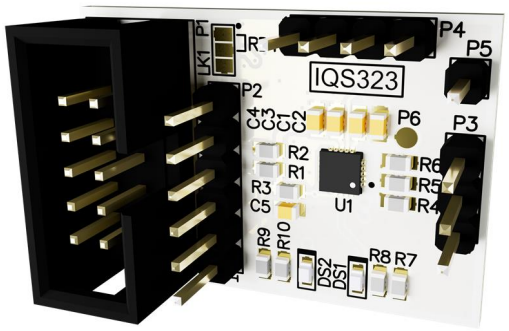

Figure 1.1: IQS323EV01 EV Kit

The IQS323EV02 EV kit contains three modules showcasing the different sensing technologies that the IQS323 provides. See the IQS323EV02 reference schematics in Section 5.2

- Inductive sensing module that showcases the use of PCB coils and SMD inductors for proximity and tactile button applications,
- Mutual-capacitive touch buttons,
- A 3-channel self-capacitive touch slider.

Figure 1.2: IQS323EV02 EV Kit

The following application notes provide background information and design guidelines for the various sensing methods supported by the IQS323.

- Azoteq Sensing Technologies: AZD004
- Capacitive Sensing Design Guide: AZD125
- Inductive Design Layout Guide: AZD115

For IC-specific information, operation, and memory map details, please refer to the IQS323 Datasheet.

2 Getting Started

This section describes the process of initial device and GUI set-up prior to application-specific tuning.

2.1 Step 1: GUI Software Installation

Download and install the Azoteq IQS323 GUI PC Software from the Azoteq website under the Software and Tools page. Extract the downloaded zip file and follow the installation wizard procedure.

2.2 Step 2: Launch GUI Software

Launch the IQS323 GUI software executable. The following window should appear:

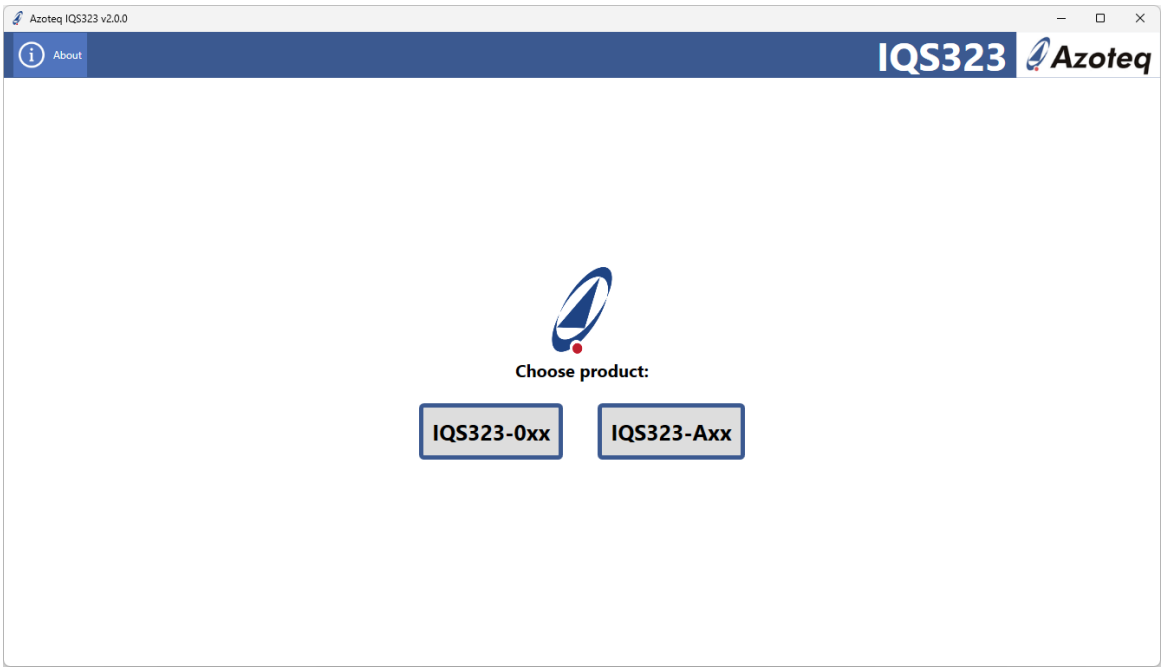

Figure 2.1: Main Window of the Azoteq IQS323 GUI

The IQS323 is available in two different variants, the IQS323-0xx and IQS323-Axx, which provide different feature sets. The IQS323 device being evaluated can be selected by clicking on either *IQS323-0xx* or *IQS323-Axx*. Note that the EV kits are only available with the *IQS323-0xx* variant, thus this guide assumes the *IQS323-0xx* variant is used.

Once the *IQS323-0xx* variant has been selected, the following window will appear:

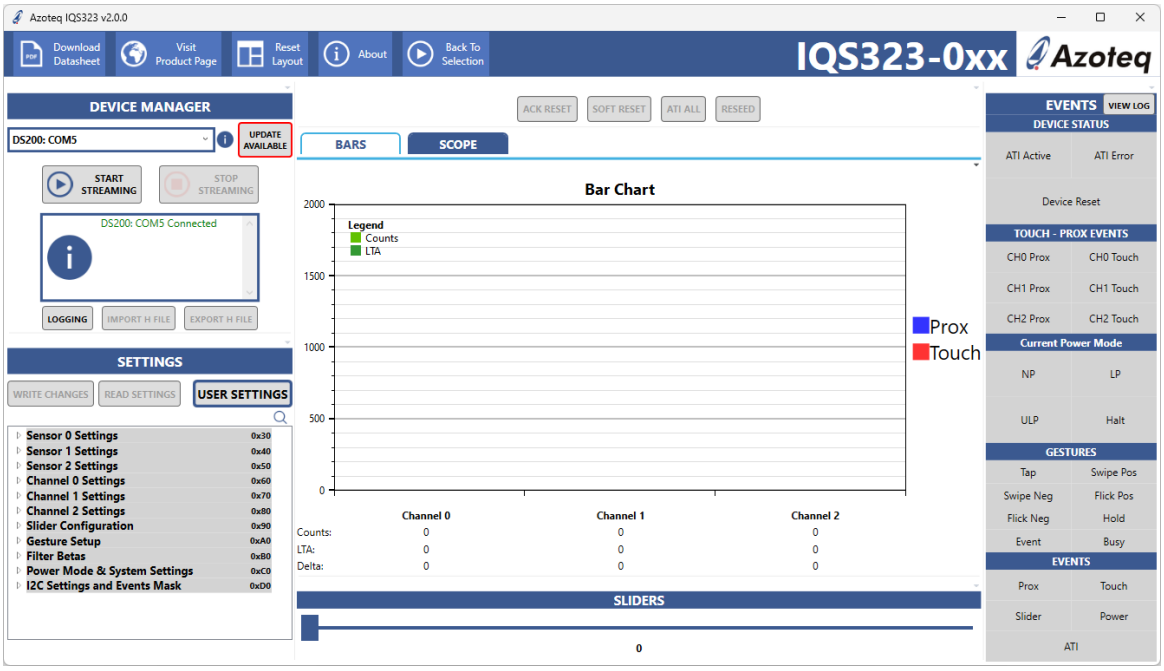

Figure 2.2: Main Window of the Azoteq IQS323 GUI

2.3 Step 3: Hardware Connections

Connect the DS200 to your PC, using a standard type-C cable. The device under test (DUT), being either an IQS323EV02 EV kit or an application PCBA, can be interfaced with a suitable 10-to-10 pin ribbon cable connection (or application-specific connections), as shown in Figure 2.4 below.

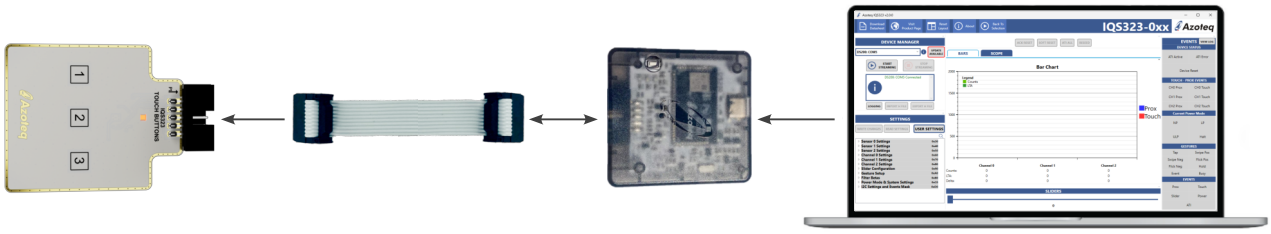

Figure 2.3: DS200 Connection for Streaming and Testing

Note: The CT210A can be used instead of the DS200, along with a standard USB-micro data cable and a suitable 20-to-10 pin ribbon cable connection, as shown in Figure 2.3 below.

Figure 2.4: CT210A Connection for Streaming and Testing

If a custom cable or hardware is used, please refer to Table 2.1 and Figure 2.5 for the required connections.

Table 2.1: DS200 Pin-out

IQS Pins	DS200 Pins
GND	Pin 1
VDD	Pin 3
SDA	Pin 7
SCL	Pin 9
RDY	Pin 10

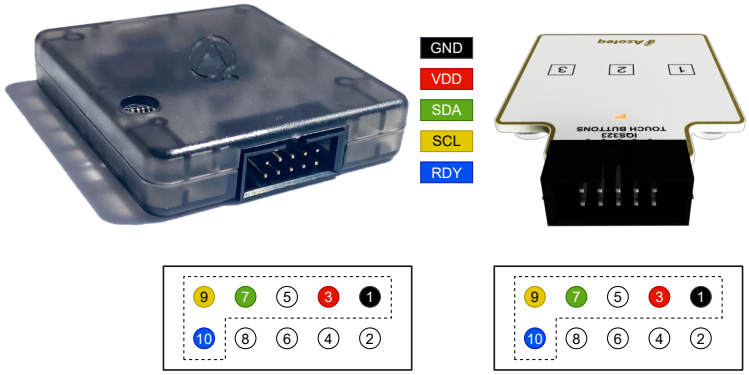

Figure 2.5: DS200 Power, I^2C and RDY Connections

2.4 Step 4: PC Connection Verification

After connecting the DS200 device to the computer, the GUI software will automatically install any necessary drivers. It will then verify the DS200 connection and firmware version, displaying a 'Device Connected' message in the configuration tool manager section, as shown in the red block in Figure 2.6.

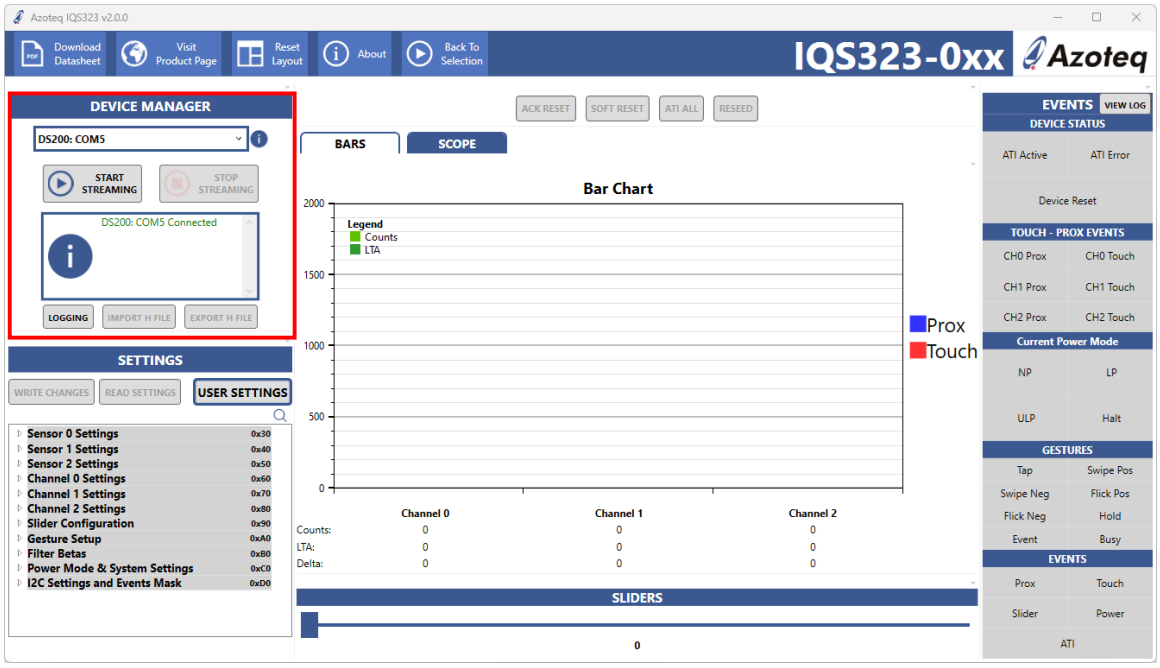

Figure 2.6: DS200 Recognition and Connection

Note: If the connected DS200 device firmware is out of date, an 'Update available' button should automatically appear next to the device enumeration. Click this button to launch the Azoteq firmware upgrade tool and update the firmware, as shown in Figure 2.7.

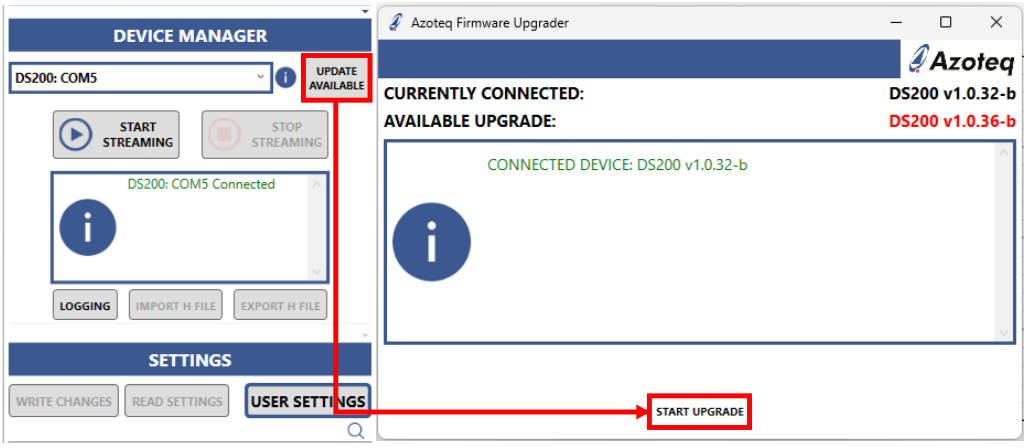

Figure 2.7: DS200 Firmware Upgrade

2.5 Step 5: Initiate IQS323 Communication (Streaming)

Click on 'Start Streaming' to initiate communications with the IQS323. Additional messages will appear and will provide the following information:

- Power status
- I^2C address
- Device version information
- Settings and streaming confirmations or errors, as applicable

Note that the IQS323 product can be ordered with different I²C addresses. The GUI will automatically try each address until the device responds.

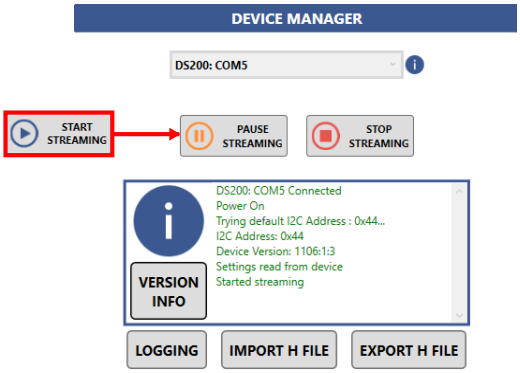

Figure 2.8: Message Dialogue Results from a Successful IQS323 Connection

If an error is displayed, please ensure that the device is properly connected and that the IQS323's product and version numbers were verified successfully.

2.6 Step 6: Acknowledge Reset and Streaming Mode

Click on the red text button 'ACK Reset' to clear the reset event flag. The 'ACK Reset' text should change colour to black, indicating successful reset acknowledgement.

Figure 2.9: ACK Reset Button

The IQS323 starts in streaming mode, as shown in Figure 2.10. The default settings are *not* an appropriate baseline for a production application.

Figure 2.10: IQS323 Streaming

2.7 Step 7: Load Pre-Configured H-File (Demo Button)

The GUI provides predefined configs for each of the EV kit modules. Open the “User Settings” window, navigate to the first tab named “EV Kit Modules”, and click on the appropriate image to apply the predefined configuration settings for the demo. Refer to Figure 2.11.

Figure 2.11: Importing the Predefined Demo Configuration

The device may now be configured further via the ‘User Settings’ window.

3 IQS323 Debug and Display Software Overview

This section briefly explains the GUI elements such as the sensor graphs, device events, and commands, as well as some additional core functionality such as data logging and exporting of device settings.

3.1 IQS323 Streaming Data

The IQS323 supports up to three ProxFusion® channels. The “counts” of each channel is a representation of the signal strength measured by the sensor.

The IQS323 GUI displays the counts of each channel in the graph panel in the centre of the GUI. The default graph view is the bar graph, which plots the instantaneous counts of each channel.

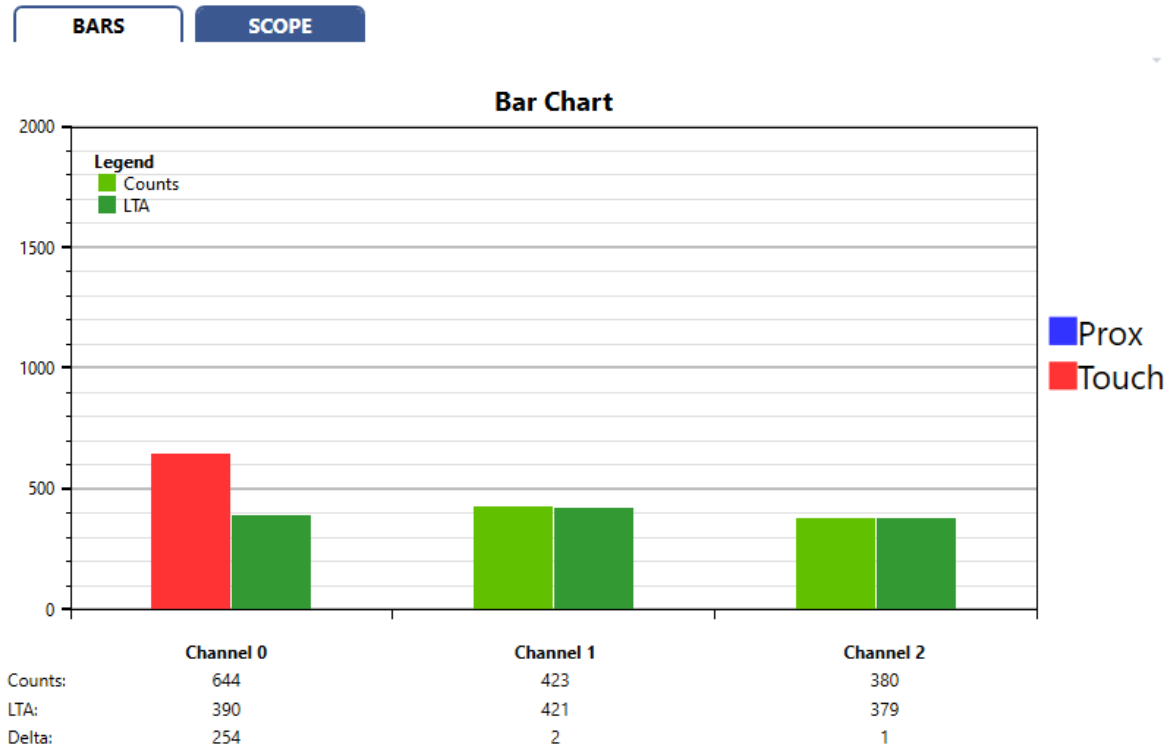

Figure 3.1: Streaming Graphs

The graph views can be manipulated with the following controls:

- Scroll wheel to zoom in and out.
- Hold and drag middle-mouse button to zoom to a bounding box.
- Hold and drag right-mouse button to pan.
- Double left-click to reset the graph view.

Note: All the signals recorded in the graphs and sliders are read directly from the IC. For more information regarding the register map, please consult the IQS323 datasheet.

3.1.1 Bar Graph

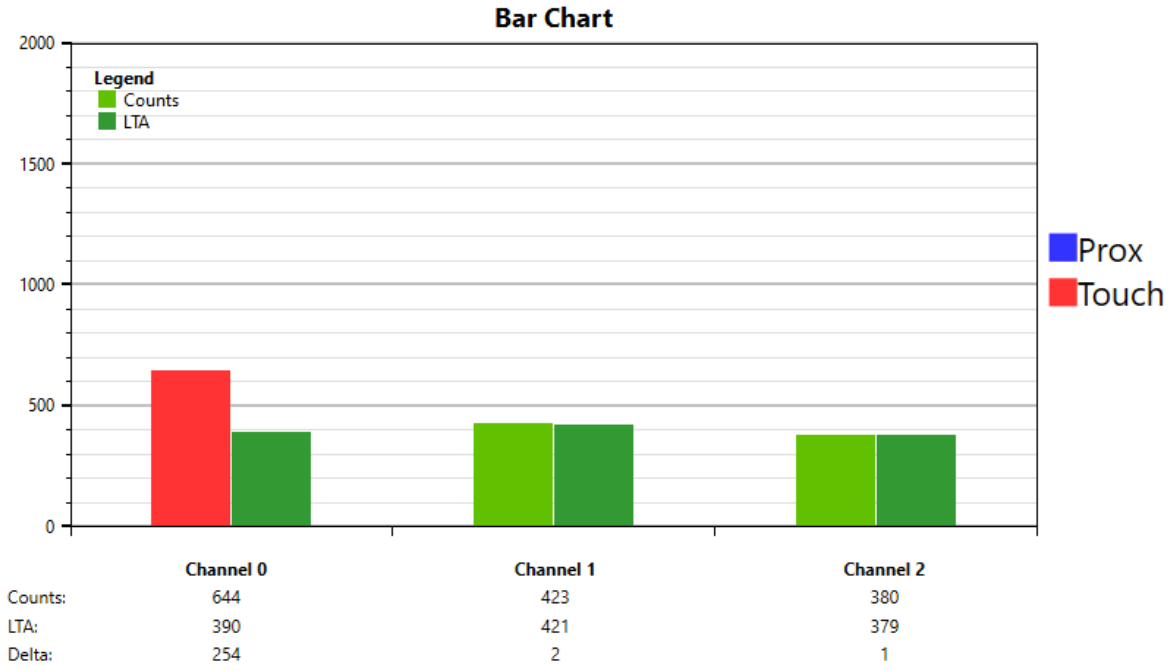

Figure 3.2: Bar Graph View of Channel Counts

For each ProxFusion® channel, the bar graph shows the counts of the capacitive/touch sensor. The **counts** value shows the raw measurement of the sensor, after filtering. The **LTA** is the Long Term Average of the counts signal. It tracks slow variations in the environment, and is used as a reference to detect movement; refer to AZD004 for more details. The **delta** is simply the difference between the LTA and the counts, and is used to detect activity or movement.

3.1.2 Scope View

The scope view plots the counts and LTAs of each ProxFusion® channel over time.

The data in the current view of the scope can be saved to a CSV file. To save the data, first click ‘Pause Streaming’ as shown in Figure 3.3.

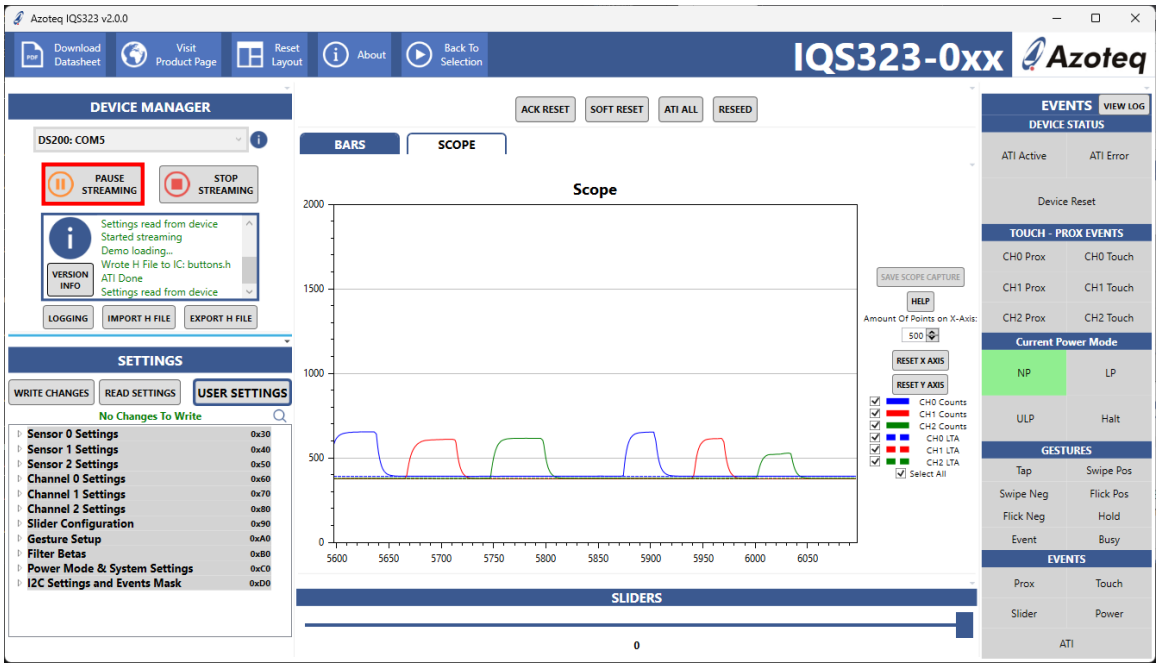

Figure 3.3: Pausing Streamed Data

Then click the ‘Save Scope Capture’ button that appears on the right of the scope view, as indicated with a green block in Figure 3.4.

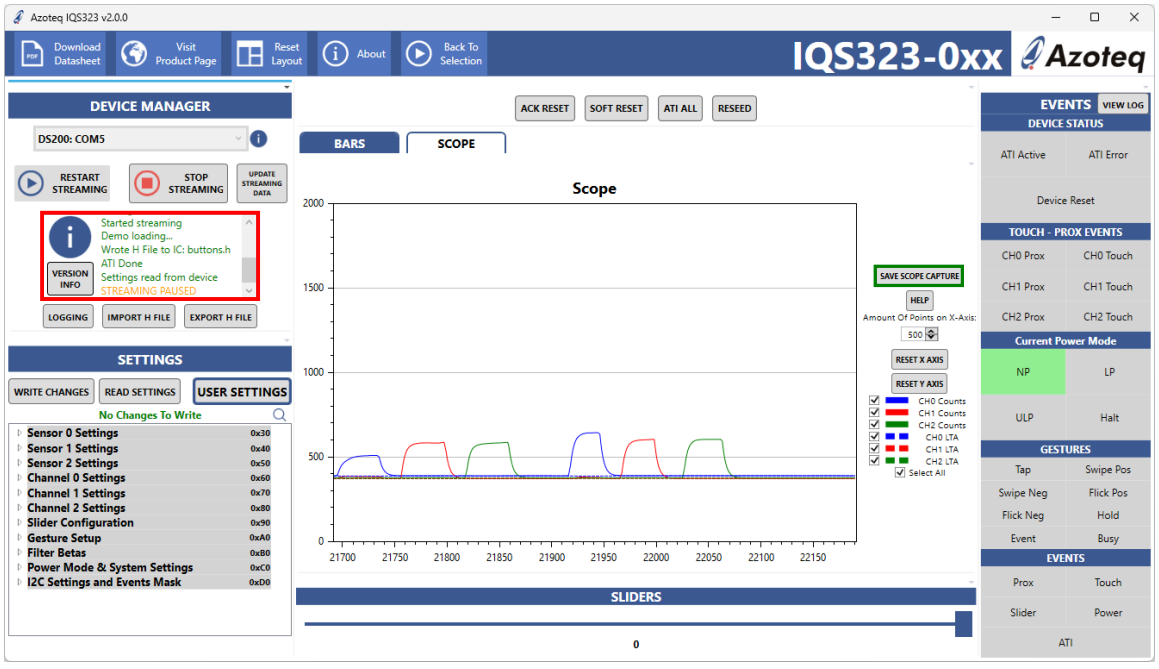

Figure 3.4: Saving Streamed Data

The following window will pop up and prompt the user to select which part of the data should be saved. Select the “Save to CSV" button to save the streamed data.

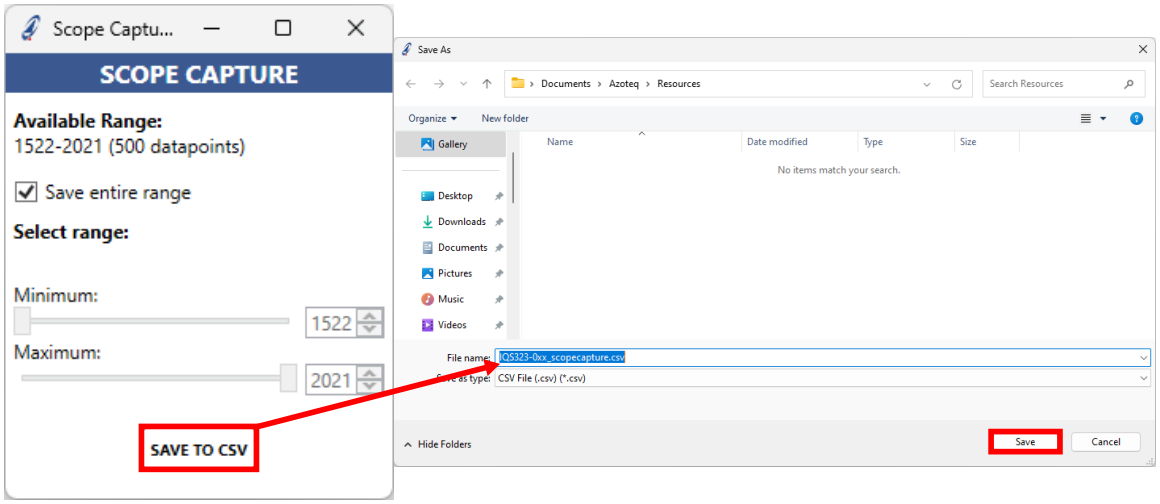

Figure 3.5: Save Streamed Data to CSV File Format

3.1.3 Slider

The IQS323 can be configured to use three capacitive sensors as a touch slider, providing features such as swipe detection. The measured coordinates of a finger on the touch slider is shown at the bottom of the GUI window.

3.2 Data Logging

It may be necessary to save all the above streaming data to a file for debugging or testing purposes. The logging function allows the GUI to save all streaming data from the IQS323 to a CSV file. Click the “Logging” button in the Configuration Tool Manager panel to open the logging window.

Figure 3.6: Logging Function Using the Configuration Tool Manager

From here, the desired variables from the IQS323 can be enabled or disabled. To start logging, click the “Start Logging” button, and choose the destination of the CSV log file.

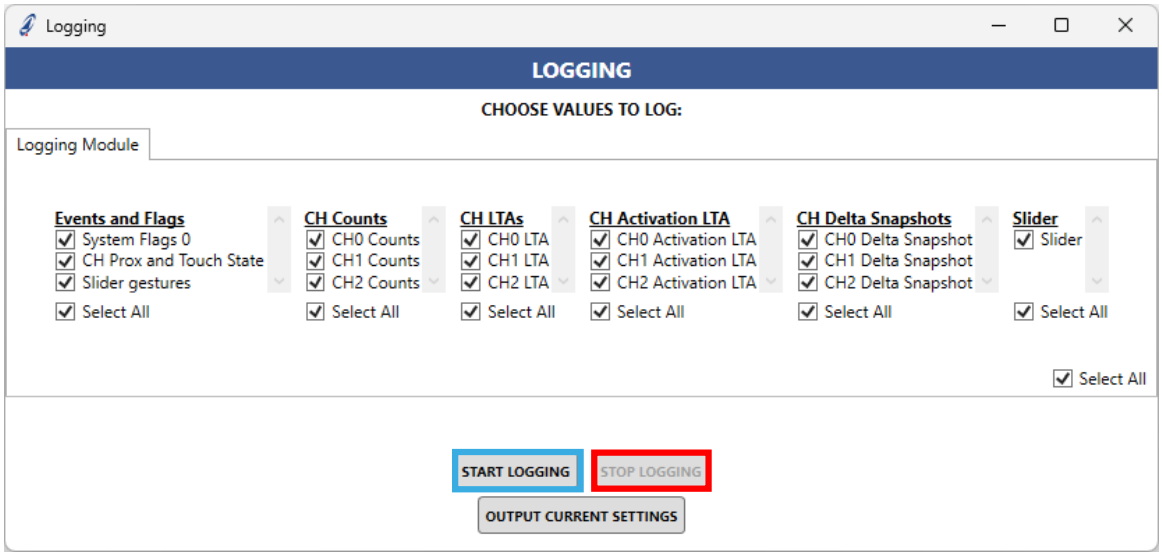

Figure 3.7: Logging Configuration Window

Once the file destination is confirmed, data logging will begin. To stop logging, click the “Stop Logging” button.

3.3 Export Device Configuration to H-File

After configuring the IQS323, you can export the new settings for safekeeping, sharing, or future use on the same or another device. The settings are exported as a *.h*-header file using the “Export H File" button.

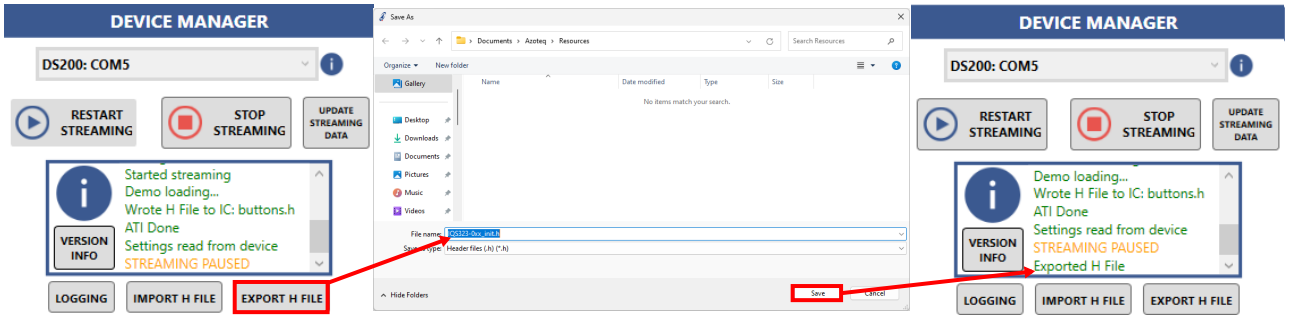

Figure 3.8: Exporting a Defined Configuration

3.4 Import Preconfigured H-File

If the device was previously configured and an associated .h-file was exported from the GUI, the file may now be imported into the GUI and loaded onto the IQS323 using the “Import H File" button.

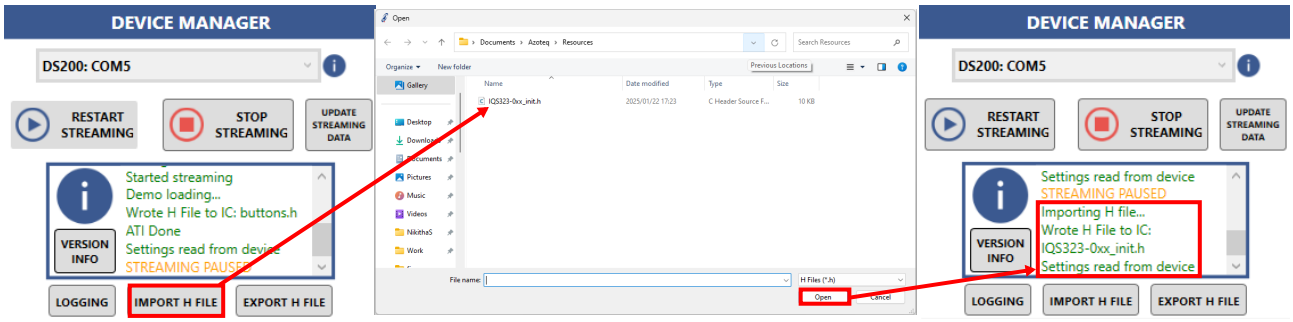

Figure 3.9: Importing a Predefined Configuration

3.5 Command Buttons

At the top centre of the GUI is a row of buttons that execute commonly-used commands.

Figure 3.10: Command Buttons

3.5.1 Acknowledge Reset

The “Ack Reset” button clears the IQS323’s reset flag by writing the **Acknowledge Reset** bit to the IC. This should be the first step after powering on any Azoteq IQS-device. On start-up, the IC will set its reset flag to indicate that a reset event has occurred.

The GUI will show that a reset has occurred by changing the Ack Reset button colour to red.

3.5.2 Soft Reset

The “Soft Reset” button issues a command to the IQS323 to perform a soft reset. This can be used to clear any configured settings back to their default values.

3.5.3 ATI All

The “ATI All” button writes the **Re-ATI** command to the IQS323. The ATI routine is a calibration algorithm on the IC that will recalibrate all the sensors to their target or reference counts.

Once ATI is complete, the GUI reads all the IQS323 settings to update any parameters that the ATI routine may have changed.

3.5.4 Reseed

The “Reseed” command can be used to update the LTA of the ProxFusion channel by setting it equal to the counts. Note that the Reseed command may trigger an ATI routine if the resulting LTA is significantly different from the target.

3.6 Events

The panel on the right-hand side of the GUI shows the current event flags that are set on the IC, as shown in Figure 3.11. These indicators are read from the IQS323's status registers.

The conditions for each event to trigger are described in the device datasheet.

3.6.1 System Status

The following events are read from the *System Status* register.

- **Device Status**:
  - ATI Active: The IQS323 is currently calibrating the channels.
  - ATI Error: The IQS323 failed to calibrate one or more channels correctly.
  - Device Reset: A reset event has occurred, and all settings have been reset to defaults.
- **Touch-Prox Status**: These flags indicate the proximity and touch status of each channel.
- **Current Power Mode**: Indicates the current power mode of the device.
- **Events**:
  - Prox: The proximity state of one of the channels has changed.
  - Touch: The touch state of one of the channels has changed.
  - Slider: A slider gesture was detected.
  - Power: The power mode has recently changed.
  - ATI: An ATI event occurred, and some calibration values may have been updated.

3.6.2 Gestures

The following events are read from the *Gesture Status* register.

- **Gestures**: The appropriate flags are set when the IQS323 detects one of the following events:
  - Tap
  - Hold
  - Swipe
  - Flick

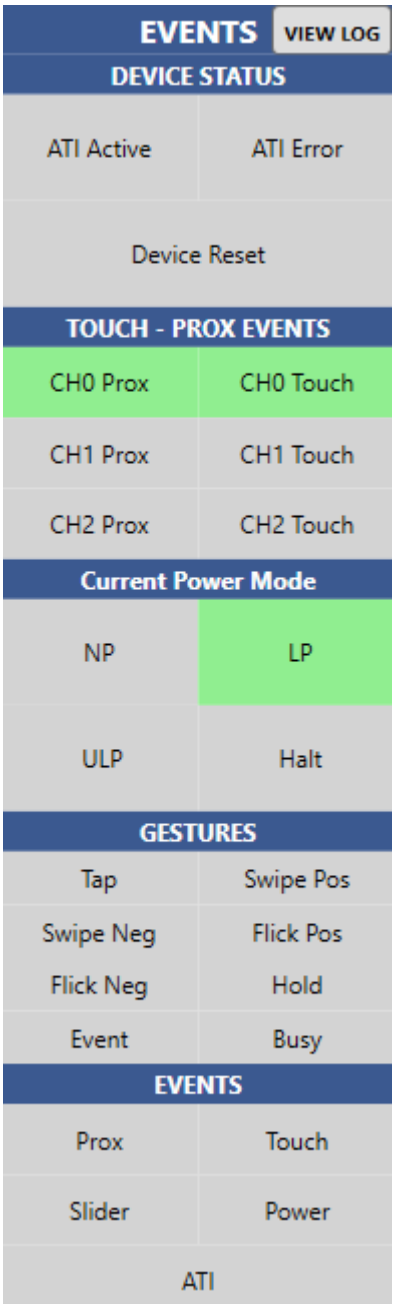

Figure 3.11: Events Panel

4 Device Setup

4.1 Power and System Settings

The “Power and System Settings” tab, shown in Figure 4.1 below, can be used to configure general settings such as the device interface and power mode selection. Furthermore, the system timing settings can also be configured, including the report rate, power mode timeout, channel event timeout, and ultra-low power settings.

Event reporting is possible when the I^2C interface is enabled and at least one of the event bits is enabled. As shown in Figure 4.1, all event bits are disabled by default.

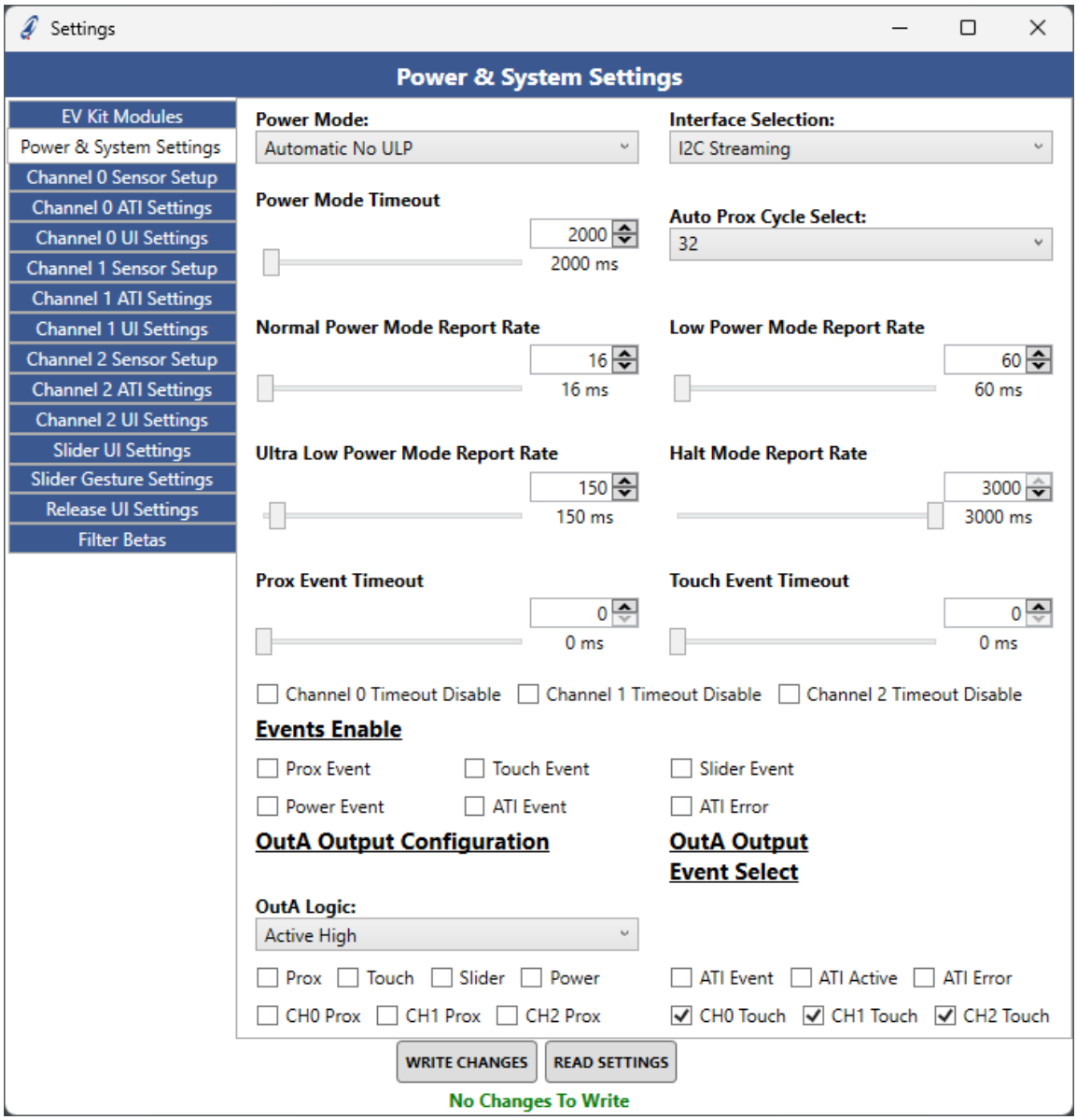

Figure 4.1: Power and Setting Settings

4.2 Channel Sensor Settings

The “Channel Sensor Settings” tab, shown in Figure 4.2, can be used to configure channel settings such as sensing mode, conversion frequency, channel pin selection, and other channel settings.

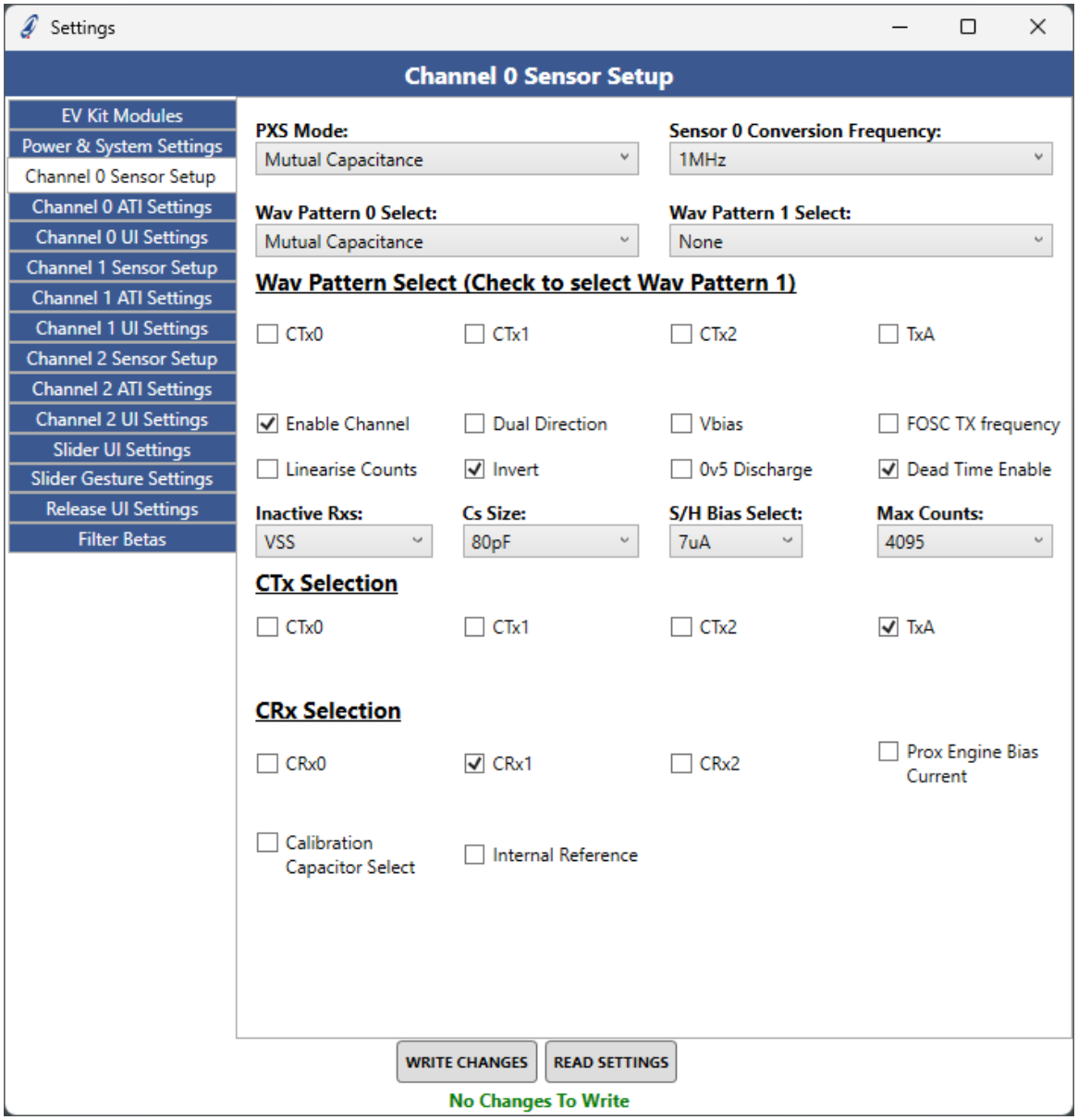

Figure 4.2: Channel Sensor Setup

4.3 Channel ATI Settings

The “Channel ATI Settings” tab, shown in Figure 4.3, can be used to configure channel ATI settings such as ATI mode, ATI resolution, ATI band, ATI base and target, mirror values and compensation values. The ATI target can be calculated using the ATI base and the ATI resolution as shown below.

$$\text{ATI Target} = \text{Actual ATI Base} \times \frac{\text{ATI Resolution Factor}}{16} \tag{1}$$

Set the ATI base and target values according to the sensitivity requirement. Refer to the IQS323 Datasheet.

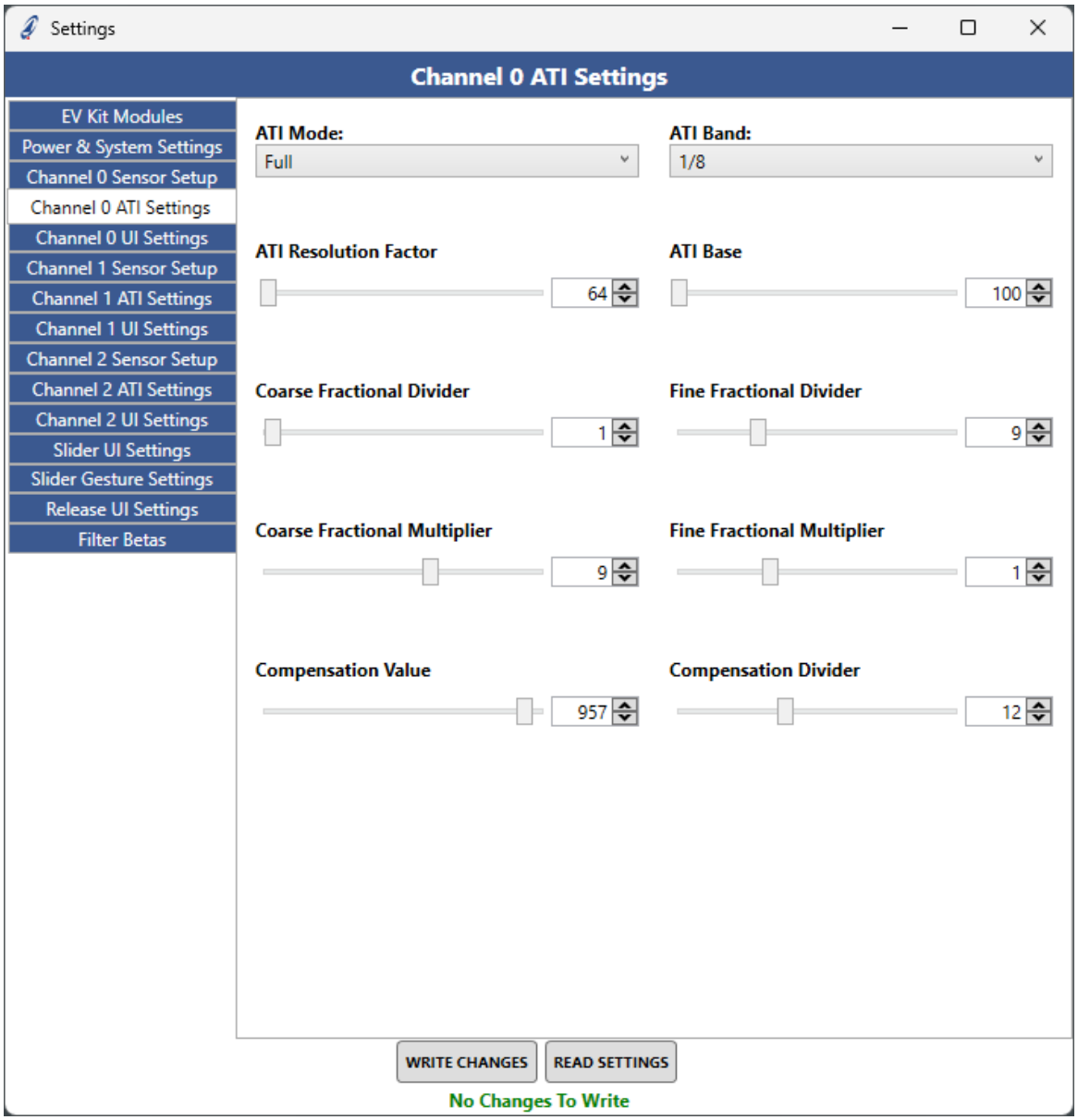

Figure 4.3: Channel ATI Settings

4.4 Channel User Interface Settings

The “Channel User Interface (UI) Settings” tab can be used to configure the channel proximity and touch thresholds, debounce values, and hysteresis settings as shown in Figure 4.4. Other settings, such as the reference and follower channel settings can also be configured as shown in Figure 4.4.

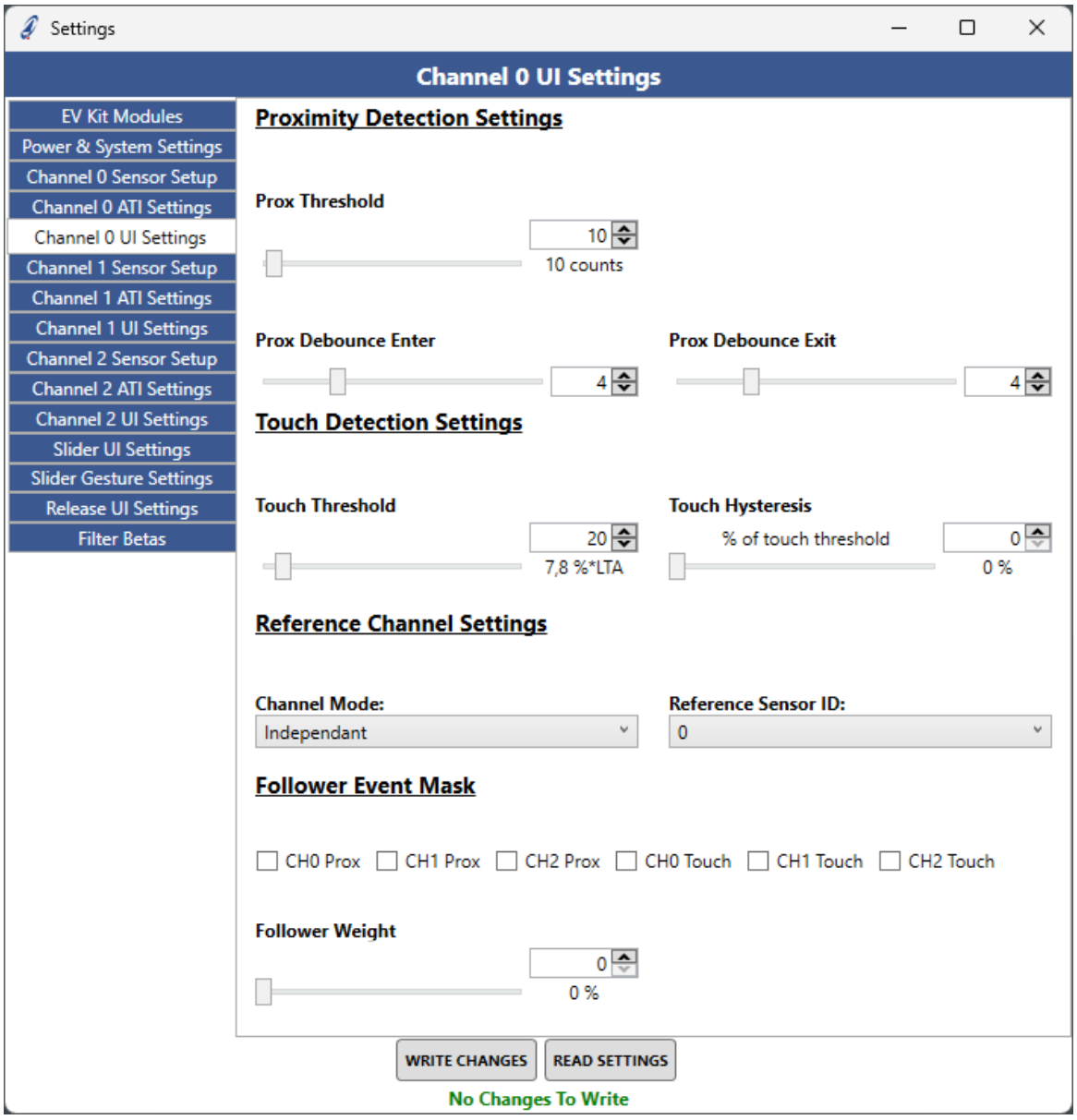

Figure 4.4: Channel UI Settings

4.5 Slider Settings

The “Slider User Interface (UI) Settings” tab can be used to configure slider settings such as resolution, calibration values, speed values, static beta values, slider channels, status pointer and delta link settings as shown in Figure 4.5.

***Note**:* The slider settings described therein are applicable to the IQS323EV02 slider module only (see Figures 5.2 and 1.2).

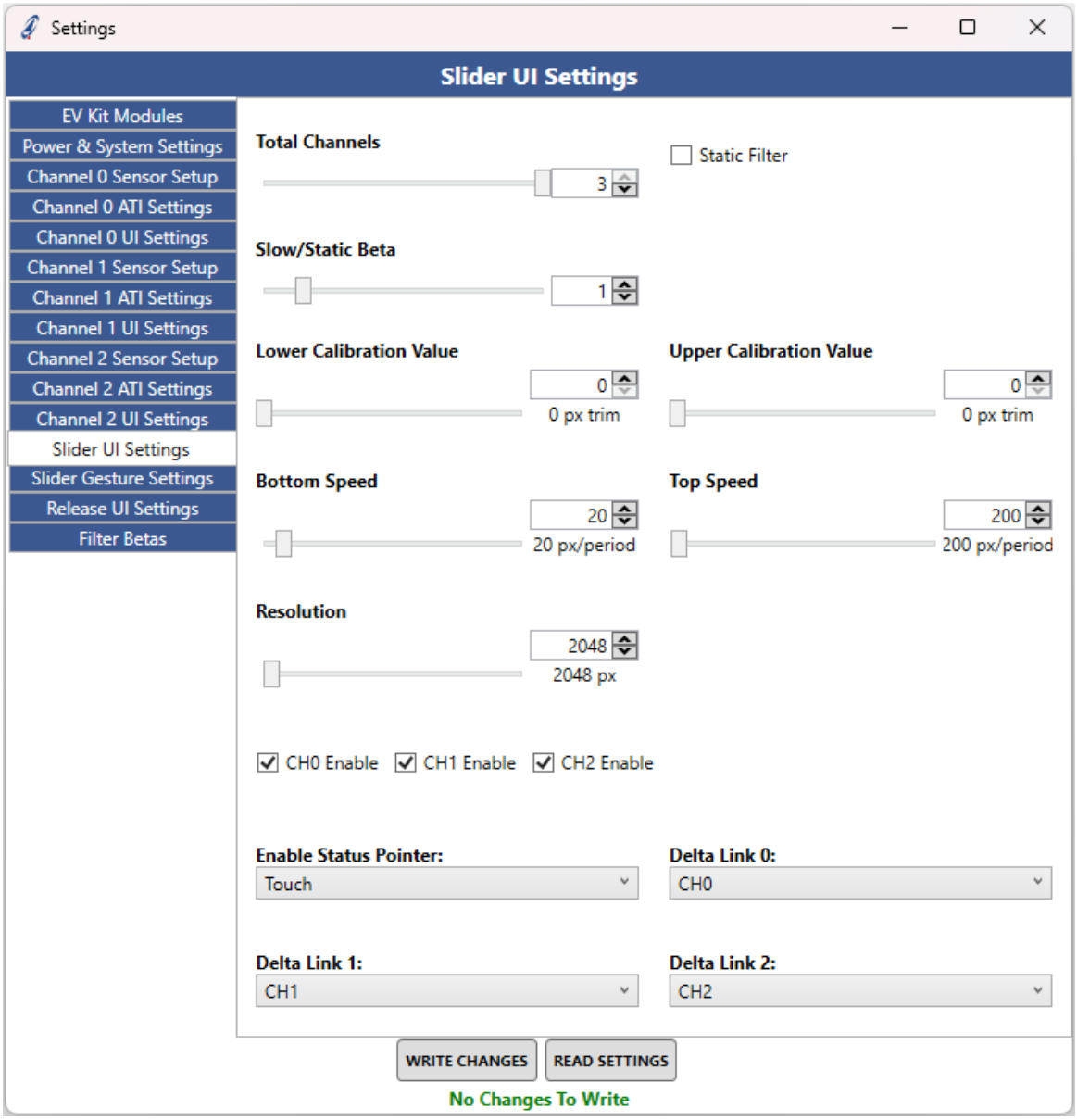

Figure 4.5: Slider UI Settings

The “Slider Gesture Settings” tab can be used to configure settings for different gestures such as tap, swipe, flick, and hold. Other gesture settings such as minimum and maximum gesture times can also be configured as shown in Figure 4.6.

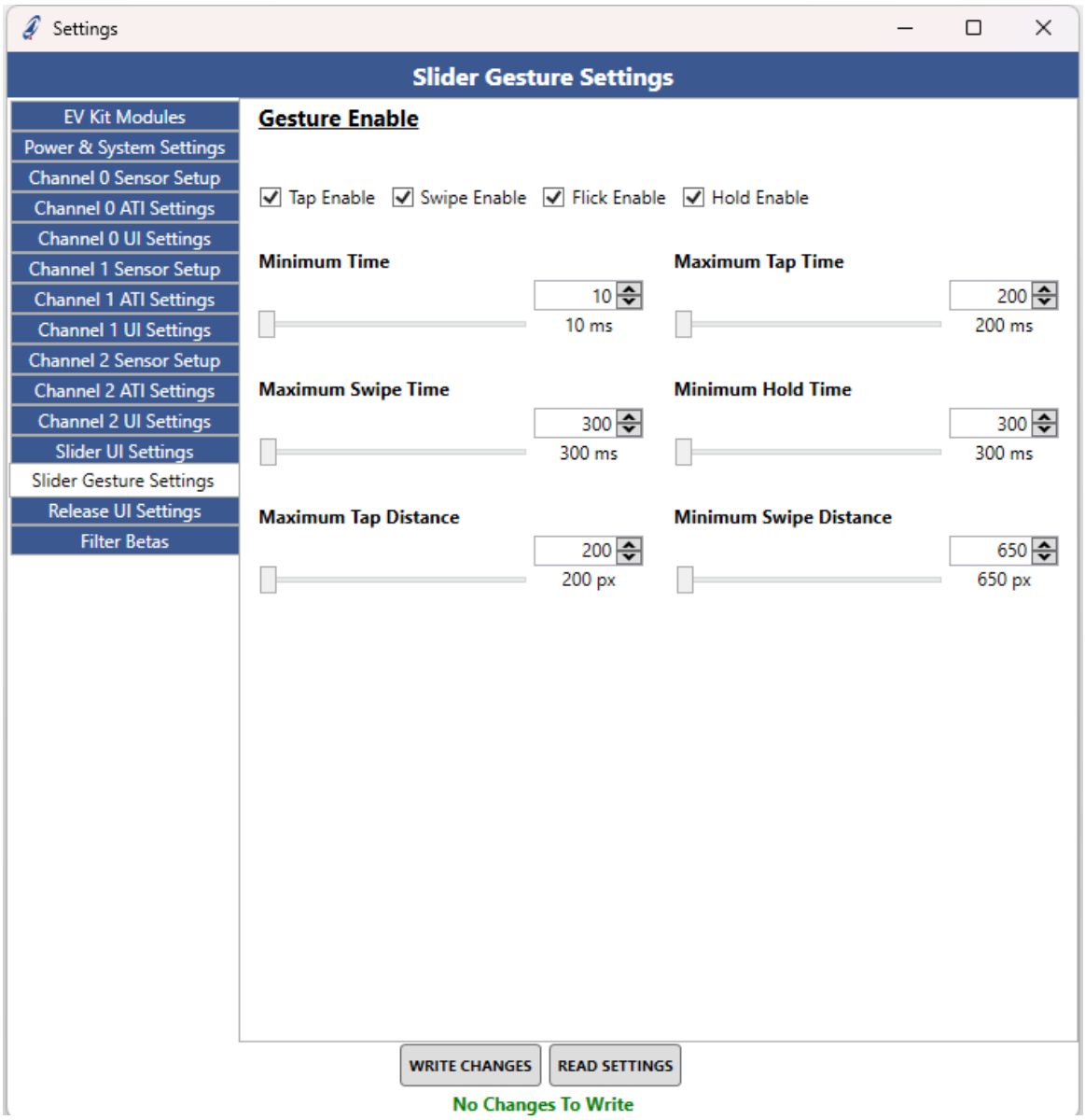

Figure 4.6: Slider Gesture Settings

4.6 Release User Interface Settings

The “Release User Interface (UI) Settings” tab can be used to enable the release UI on different channels. Other settings such as the activation settling threshold, release delta percentage, and delta snapshot sample delay can also be configure as shown in Figure 4.7.

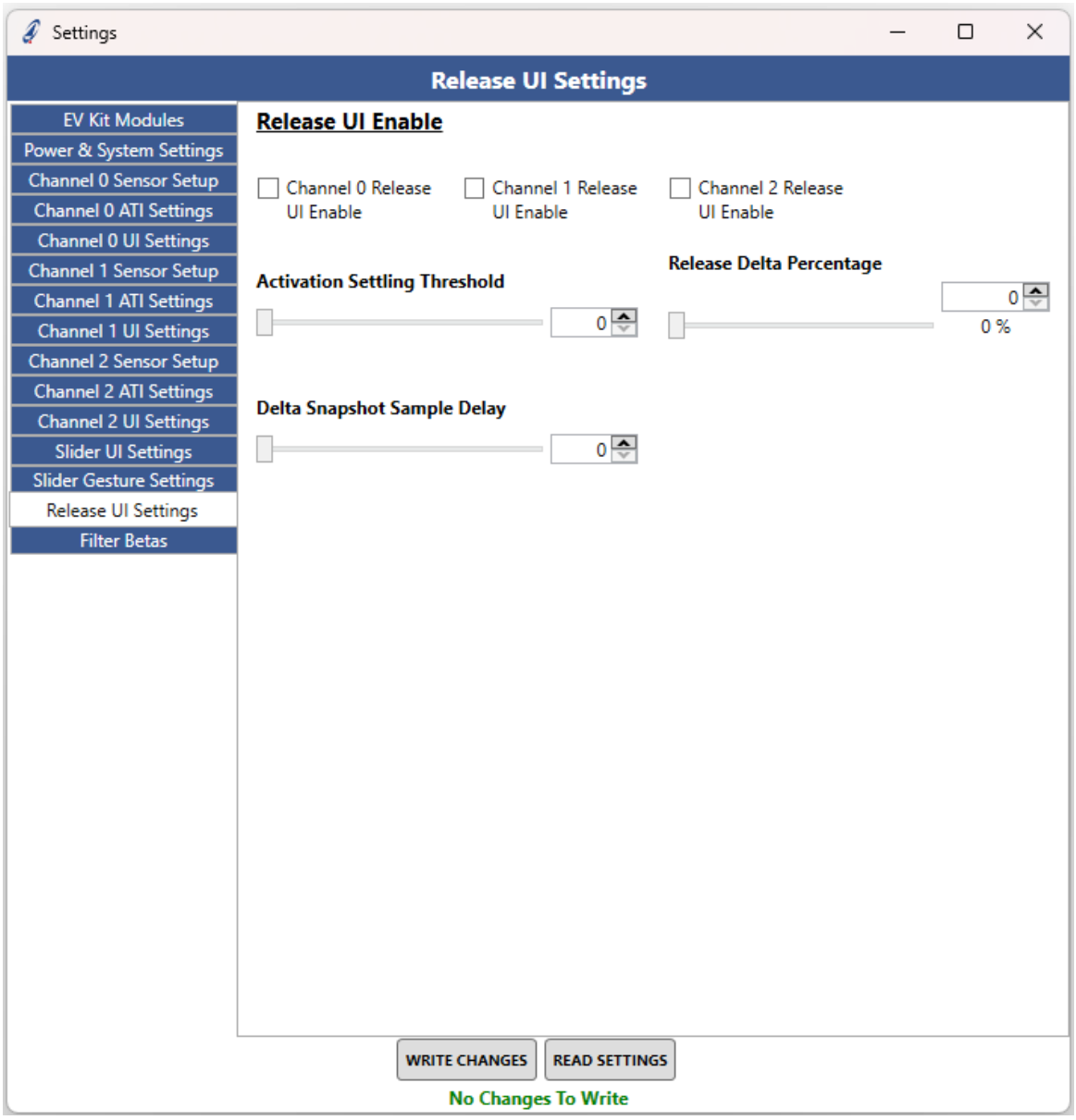

Figure 4.7: Release UI Settings

4.7 Filter Beta Settings

The “Filter Beta Settings” tab can be used to configure the channel filter settings as shown in Figure 4.8. Filter beta settings include normal power and ultra-low power filter beta settings such as counts filter beta, LTA filter beta, LTA fast filter beta, and fast filter band.

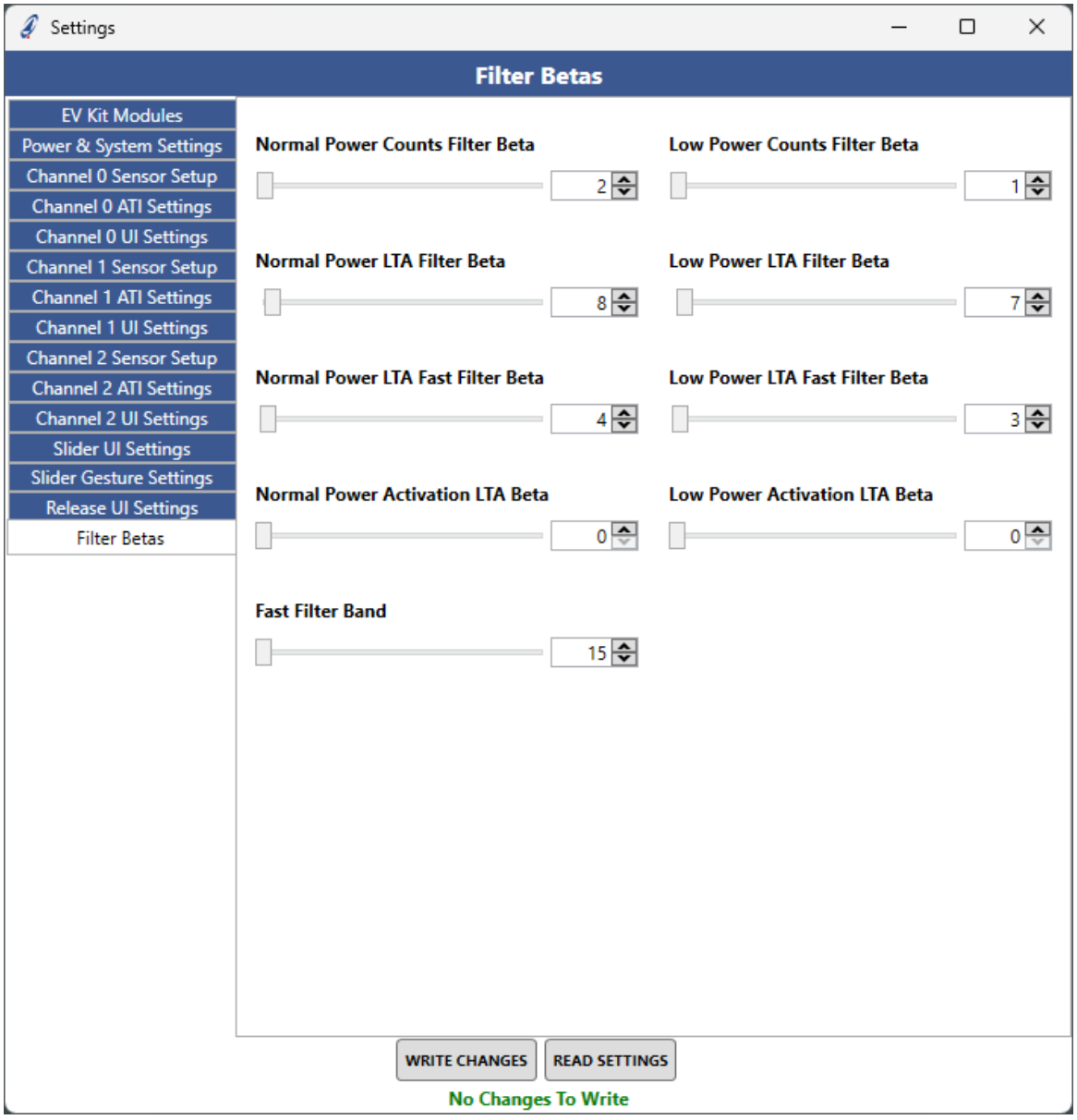

Figure 4.8: Filter Beta Settings

5 Reference Design

5.1 IQS323EV01

5.1.1 General-Purpose Stamp Module

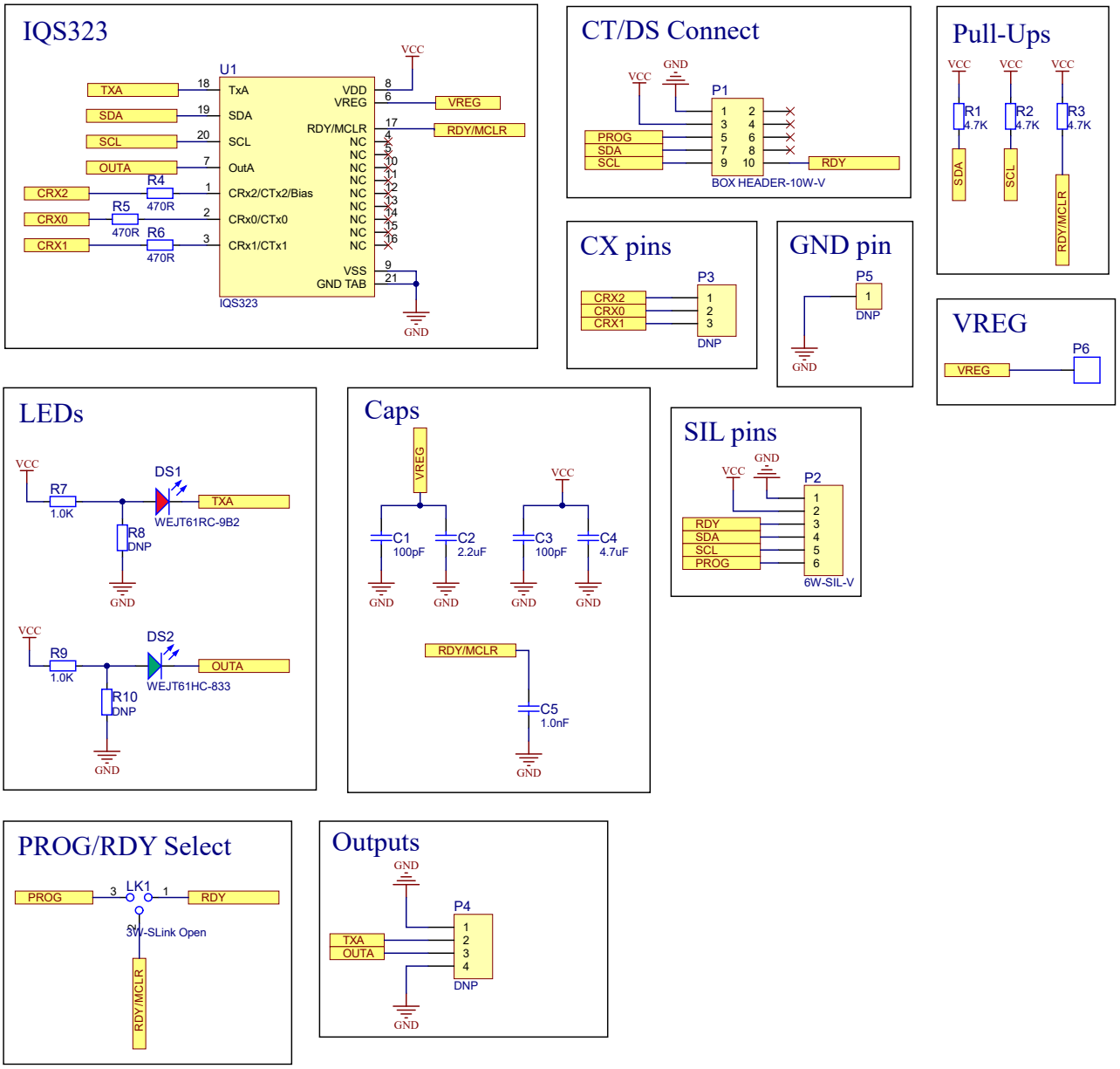

Figure 5.1: General-Purpose Stamp Reference Schematic

5.2 IQS323EV02

5.2.1 Touch Slider Module

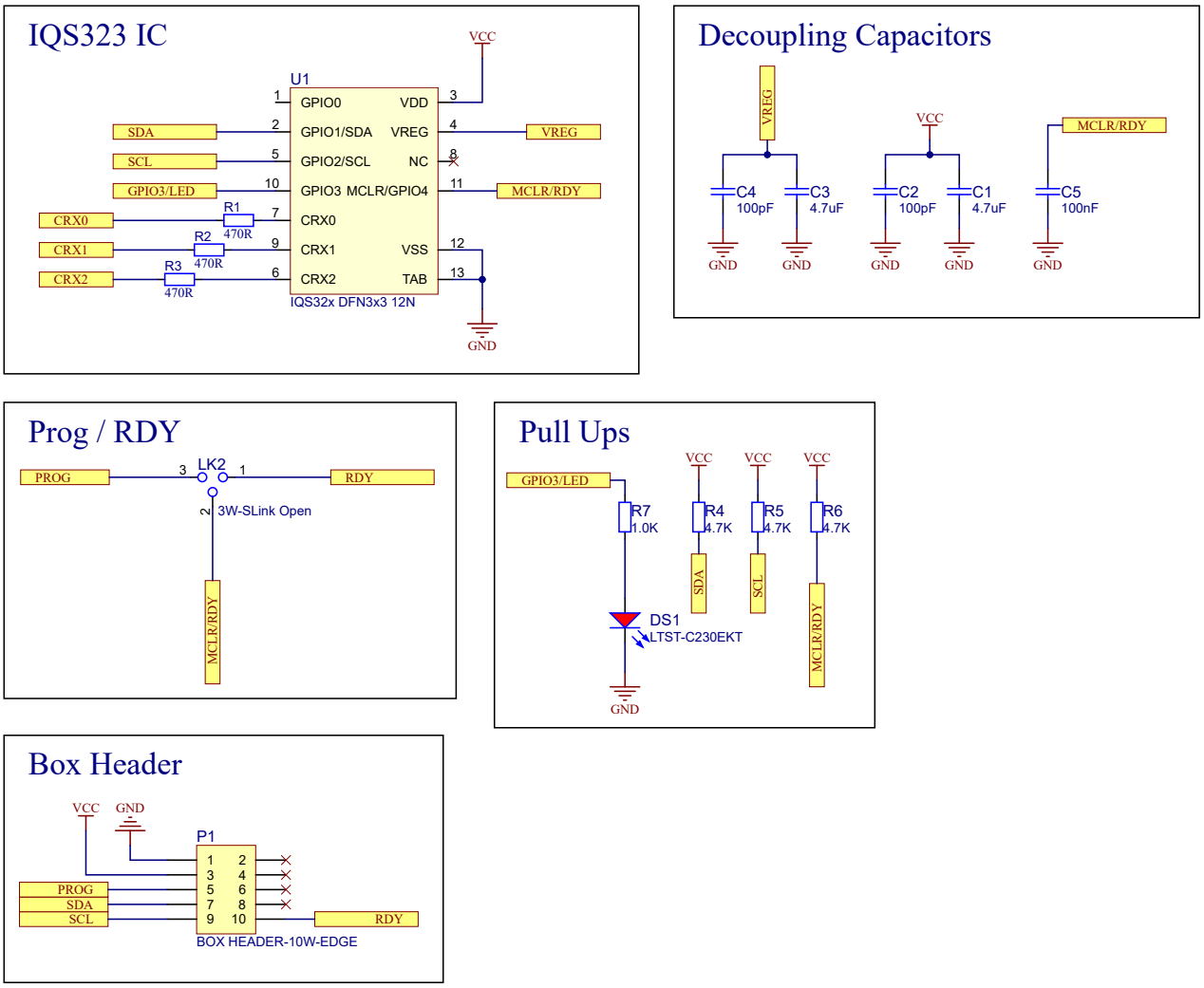

Figure 5.2: Touch Slider Reference Schematic

5.2.2 Touch Buttons Module

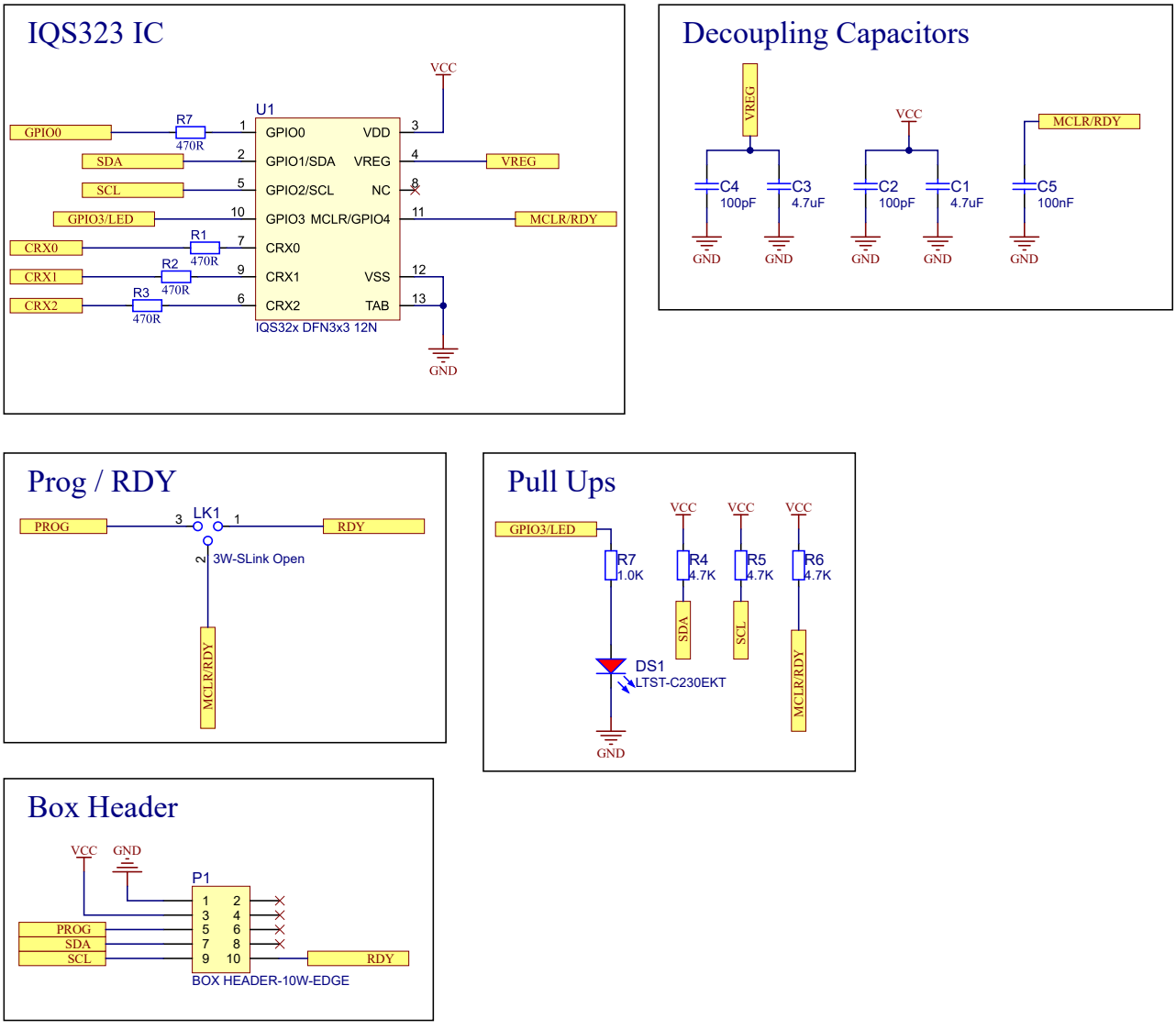

Figure 5.3: Touch Buttons Reference Schematic

5.2.3 Inductive Sensing Module

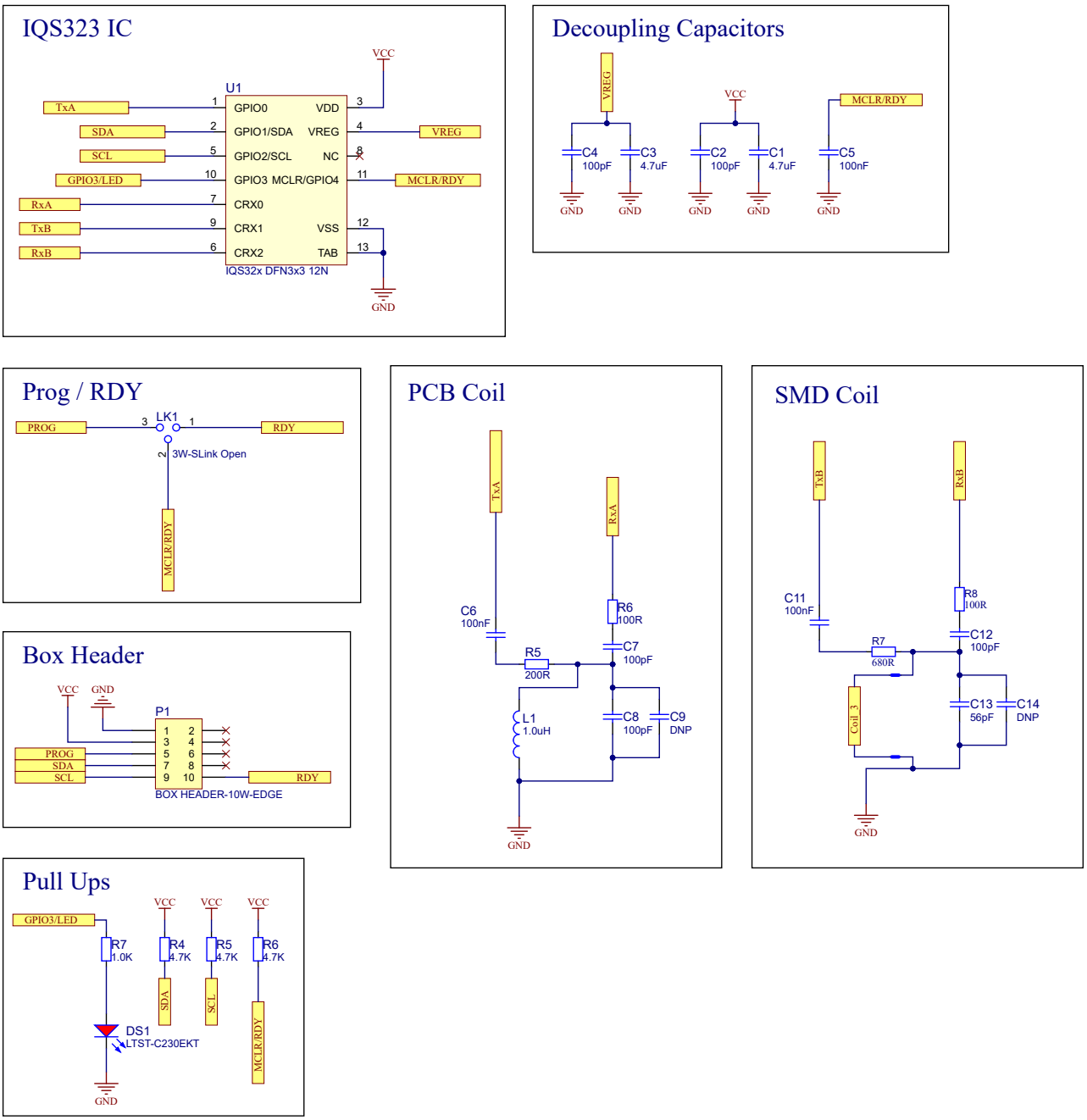

Figure 5.4: Inductive Sensing Reference Schematic

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