IQS7229A User Guide

This User Guide is meant to be used to configure the IQS7229AEV02 using the GUI PC software

Contents

1 Introduction

This document provides an overview of the graphical user interface (GUI) for the IQS7229A Debug and Display software. The GUI can be used to configure the IQS7229A for a specific application and evaluate its performance in real time. This document uses the IQS7229AEV02 EV kit, shown below in Figure 1.1, as an example and thus does not cover all applications. Instead, 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. For guidelines on the hardware and electrode design, please refer to the appropriate application notes. For IC-specific information, operation, and memory map details, please refer to the IQS7229A Datasheet.

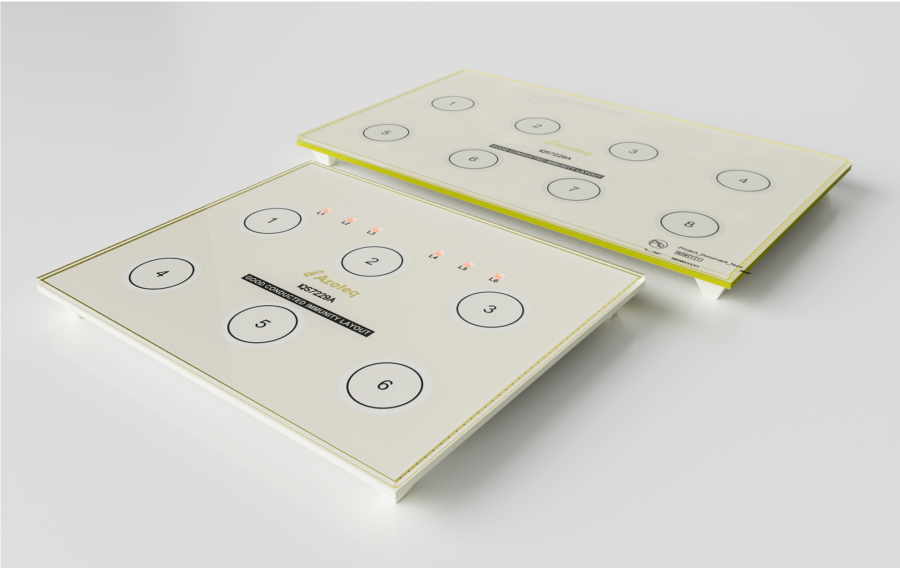


Figure 1.1: IQS7229AEV02 EV Kits

2 Getting Started

This section describes the process of initial device set-up prior to application-specific tuning. The 8-channel (AZP1376C1) EV kit is used as an example.

2.1 Step 1: GUI Software Installation

Download and install the Azoteq IQS7229A GUI PC Software from the Azoteq website under the Software and Tools page. Extract the downloaded zip file, follow the installation wizard procedure.

2.2 Step 2: Launch GUI Software

Launch the software executable program. The following window should appear:

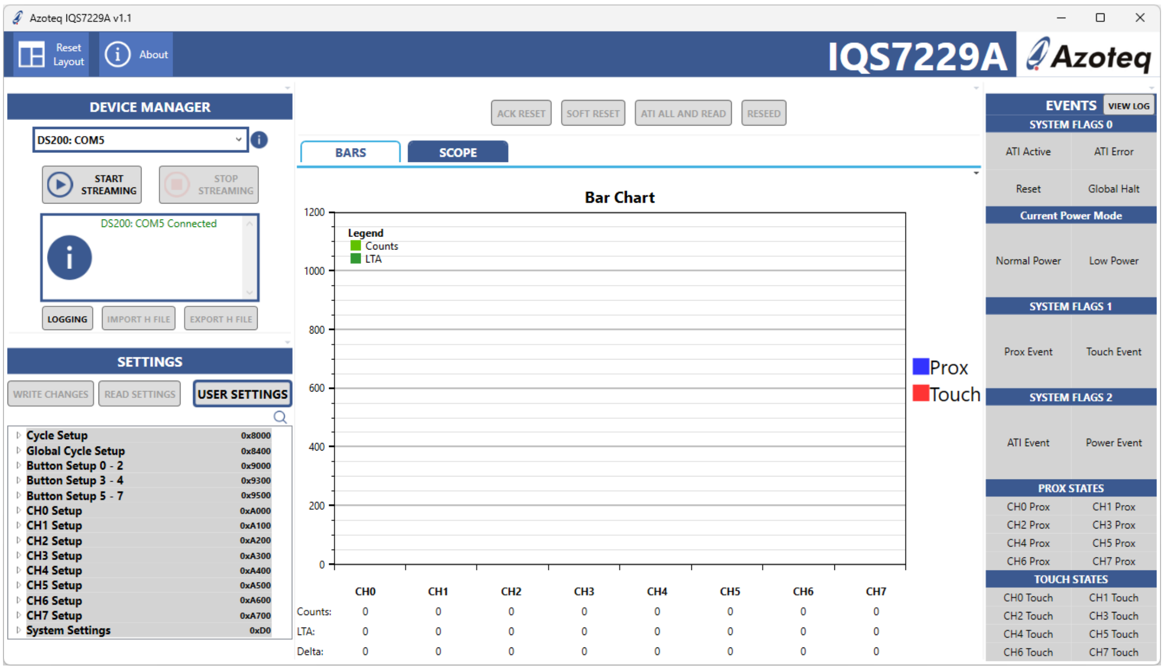


Figure 2.1: Main Window of the Azoteq IQS7229A GUI

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 IQS7229AEV02 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 2.2 below.

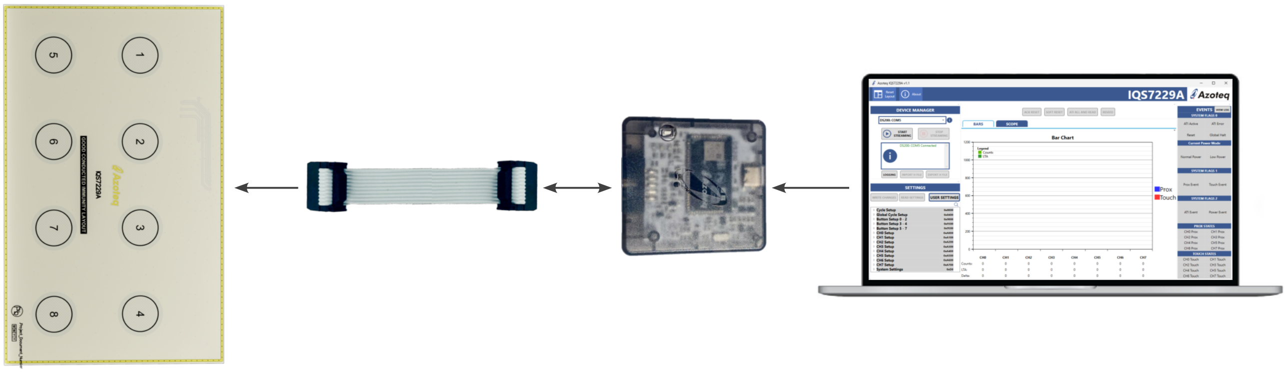


Figure 2.2: DS200 Connection for Streaming and Testing

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 2.3: CT210A Connection for Streaming and Testing

If a custom cable or hardware is used, the required connections are shown in Table 2.1 and Figure 2.4 below.

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

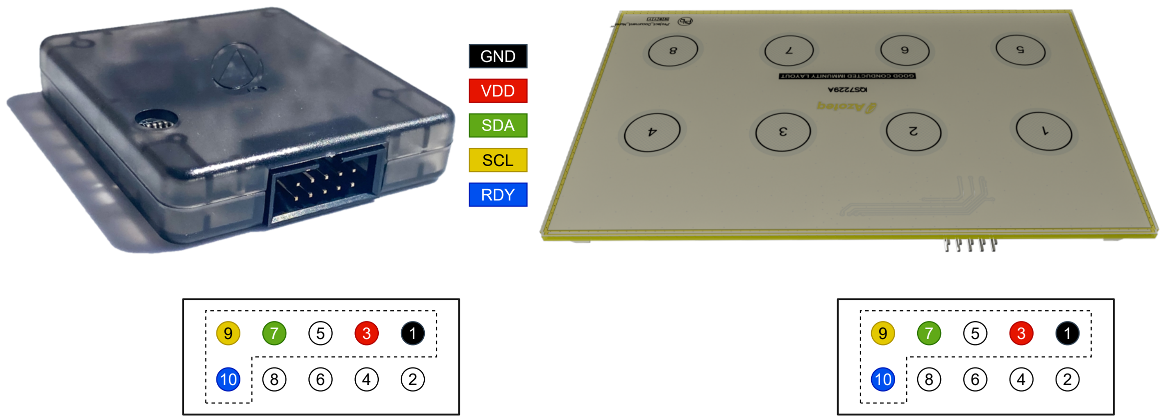


Figure 2.4: DS200 Power, I^2C and RDY Connections

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 its connection and firmware, displaying a 'Device Connected' message in the configuration tool manager section, as shown in the red block in Figure 2.5.

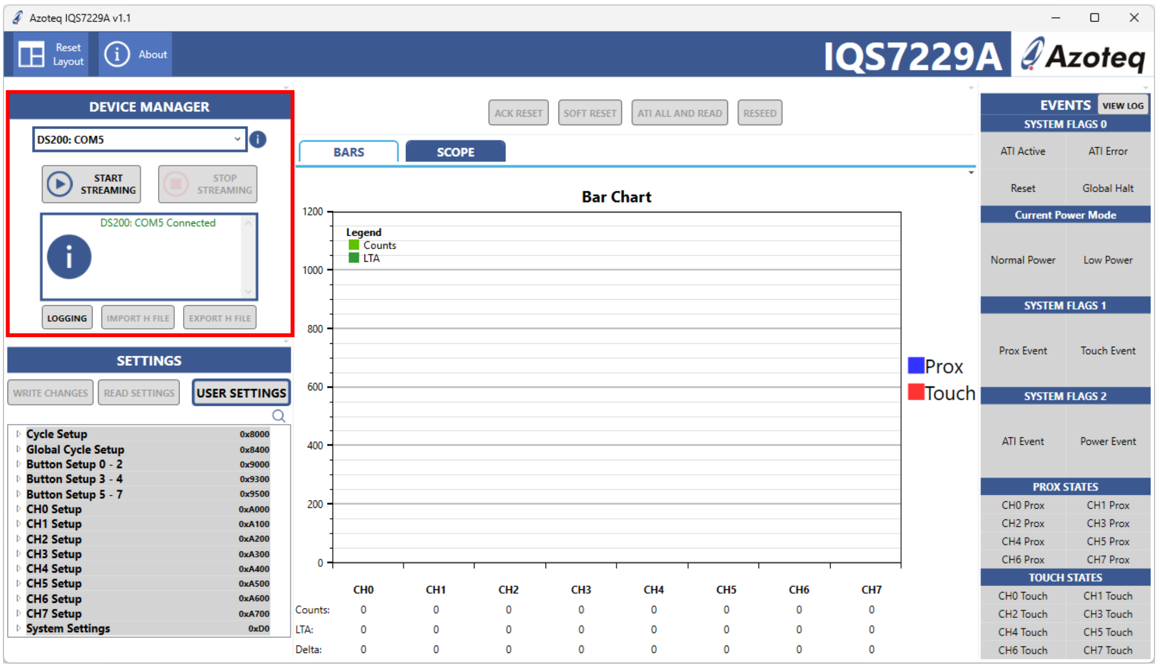


Figure 2.5: DS200 Recognition and Connection

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 2.6.

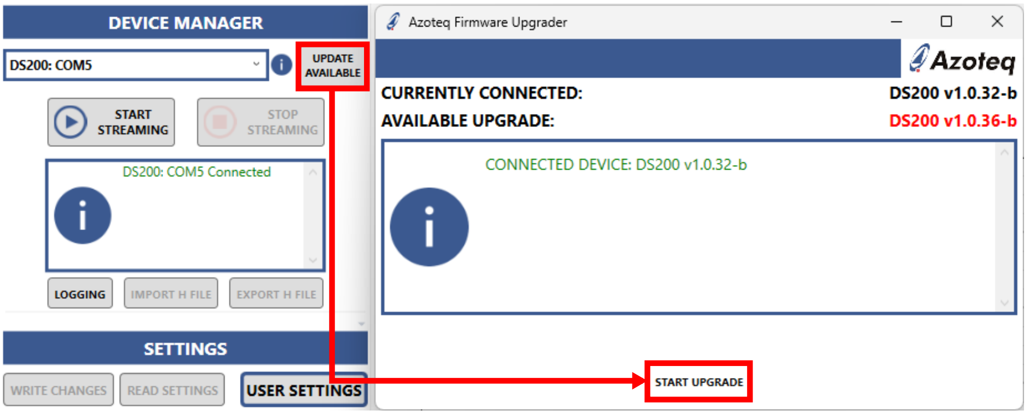


Figure 2.6: DS200 Firmware Upgrade

2.5 Step 5: Initiate IQS7229A Communication (Streaming)

Click on 'Start Streaming' to initiate communications with the IQS7229A. 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

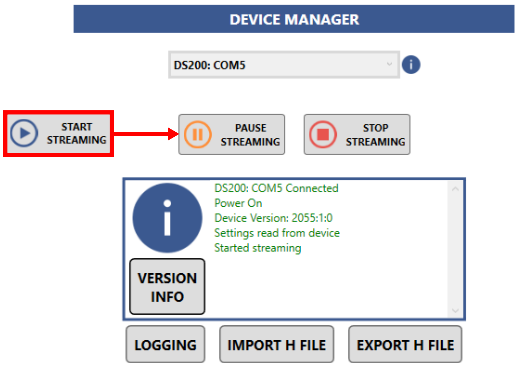


Figure 2.7: Message Dialogue Results from a Successful IQS7229A Connection

If an error is displayed, please ensure that the device is properly connected and that the IQS7229A'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 text 'ACK Reset' should change colour to black, indicating successful reset acknowledgement, and should remain so thereafter.

Figure 2.8: ACK Reset Button

The IQS7229A starts in streaming mode, as shown in Figure 2.9. The default settings are *not* an appropriate baseline for a production application.

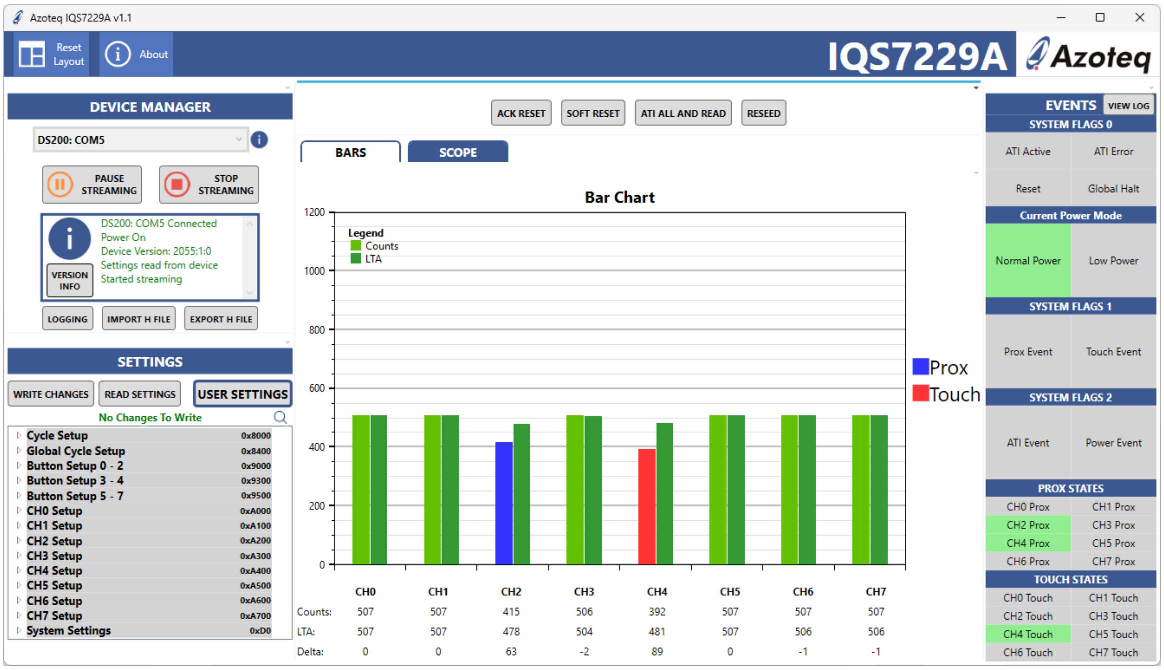


Figure 2.9: IQS7229A Streaming

2.7 Step 7: Configure IQS7229A EV kit

The device may now be configured by selecting the 'User Settings' button to open the pop-up window, as shown in Figure 2.10 below, with settings organized in menu tabs. Refer to Sections 4, 5 and 6 for more detail. The pop-up user settings window can be used to configure all the IQS7229A device parameters.

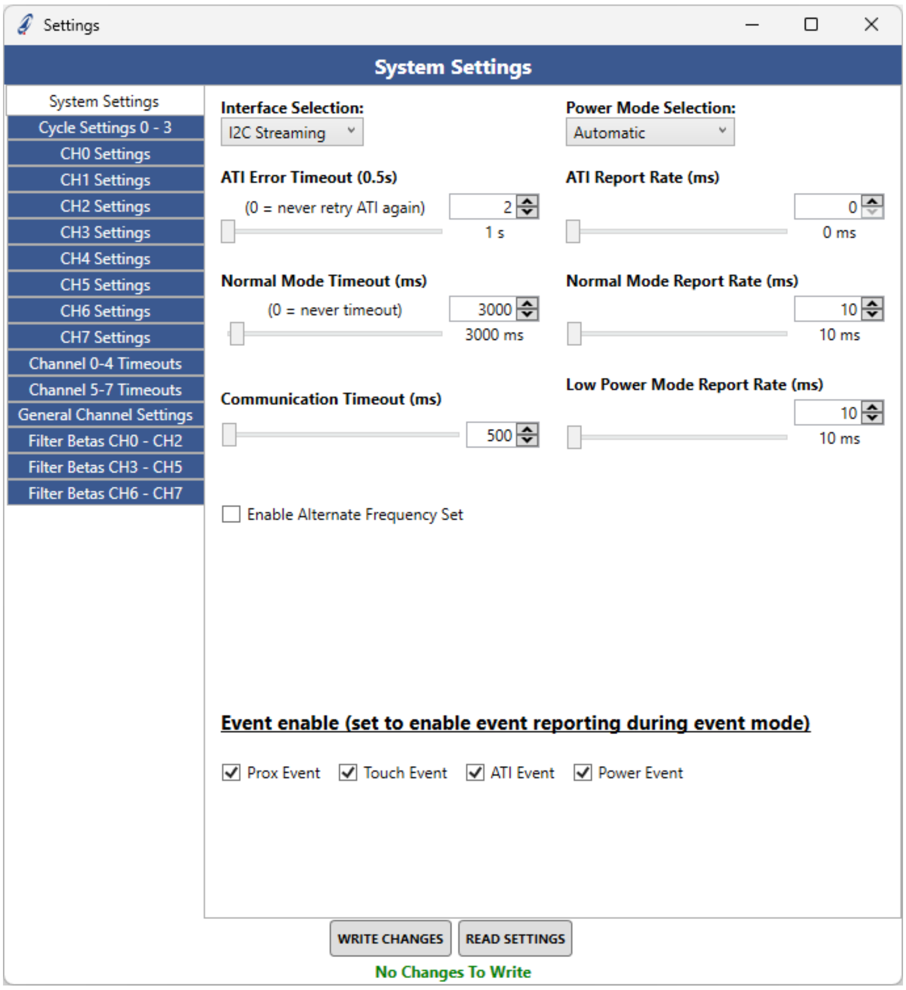


Figure 2.10: User Settings Window

3 IQS7229A 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 IQS7229A Streaming Data

The IQS7229A GUI displays all the streaming data 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. There is an additional scope view that plots additional information over time. This is explained later in this document, where relevant.

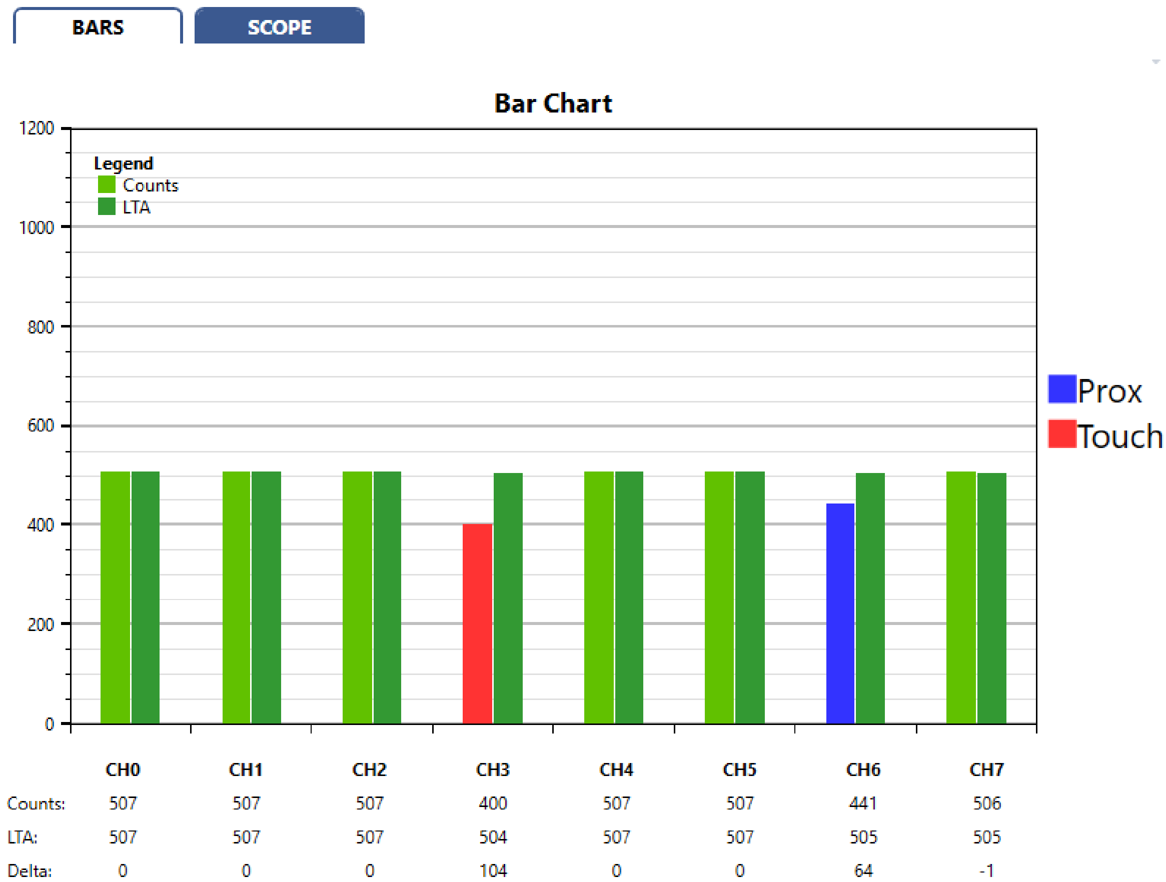


Figure 3.1: Streaming Graphs

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 are read directly from the IC. For more information regarding the register map, please consult the IQS7229A datasheet.

3.1.1 Bar Graph

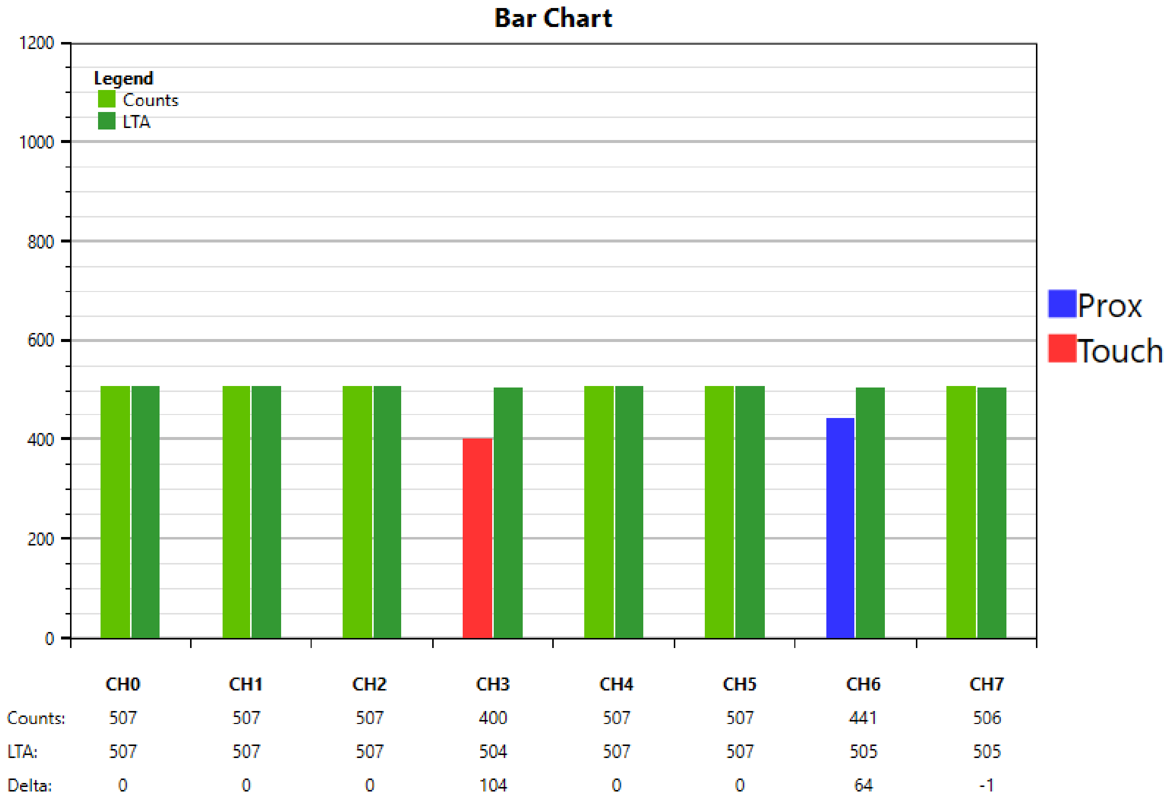


Figure 3.2: Bar Graph View of Channel Counts

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.

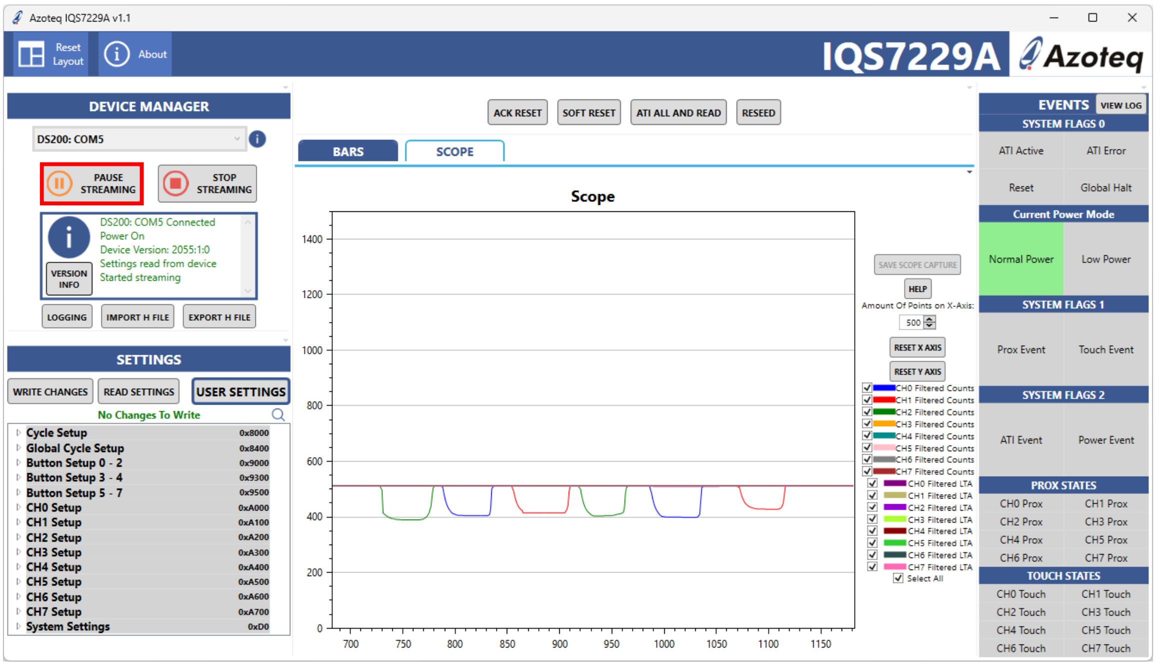


Figure 3.3: Pausing Streamed Data

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.

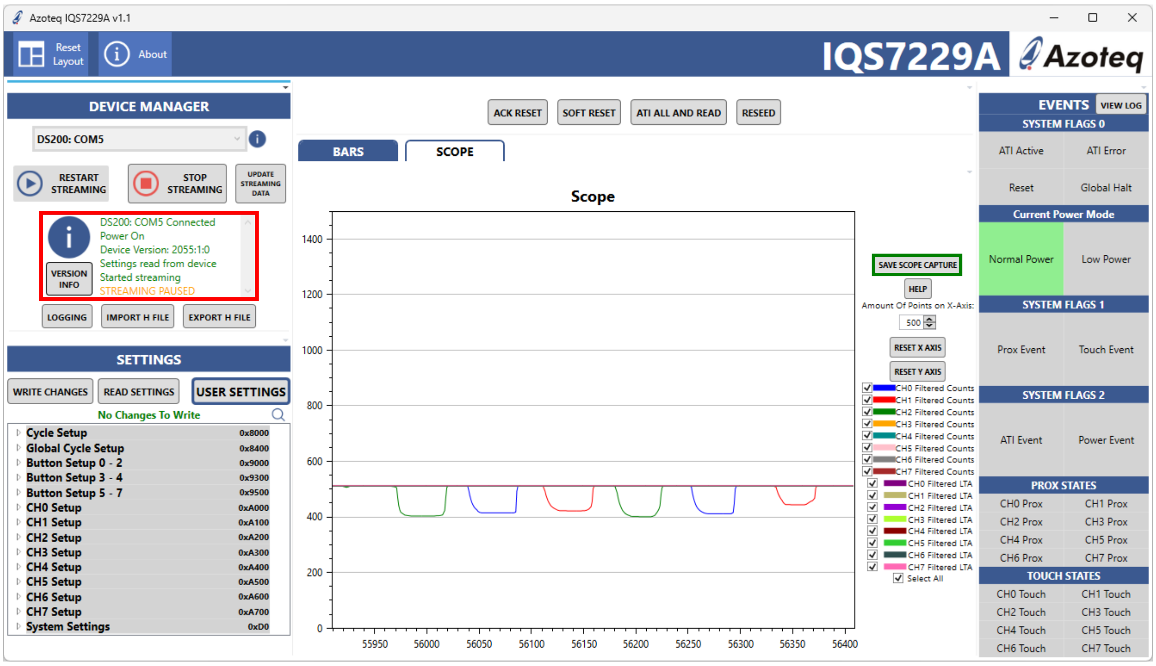


Figure 3.4: Saving Streamed Data

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.

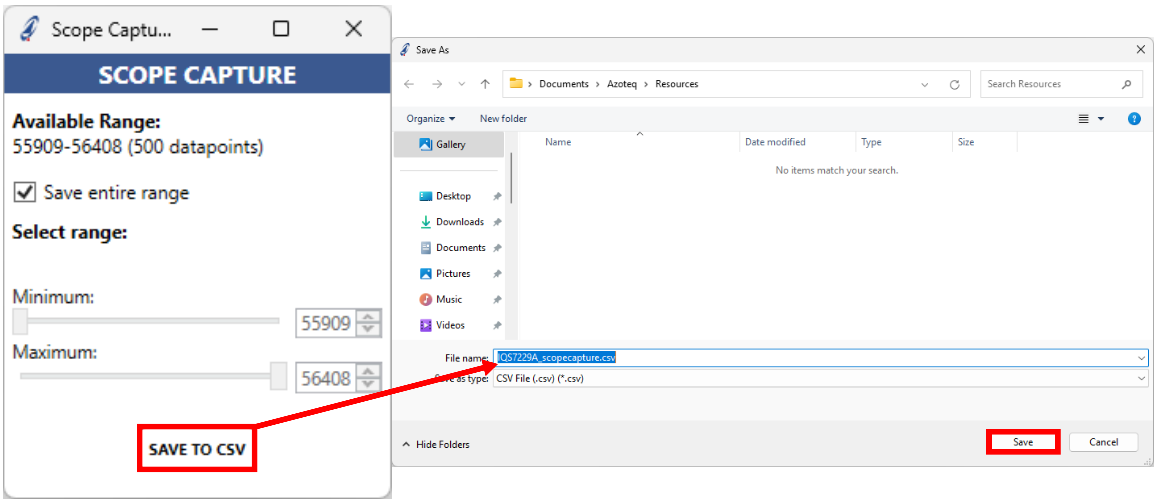


Figure 3.5: Save Streamed Data to CSV File Format

3.2 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 IQS7229A to a CSV file. Click the "Logging" button in the Configuration Tool Manager panel to open the logging window.

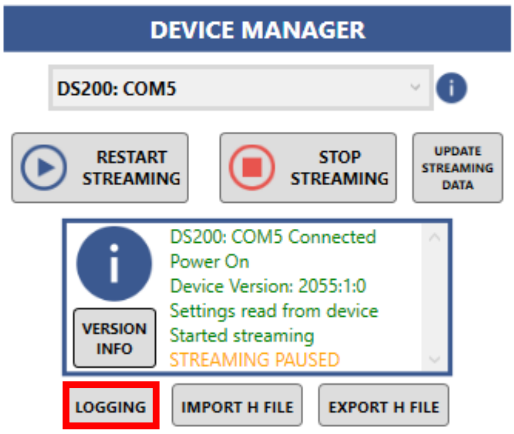


Figure 3.6: Logging Function Using the Configuration Tool Manager

From here, the desired variables from the IQS7229A can be enabled or disabled. To start logging, click the "Start Logging" button, and choose the destination of the CSV log file.

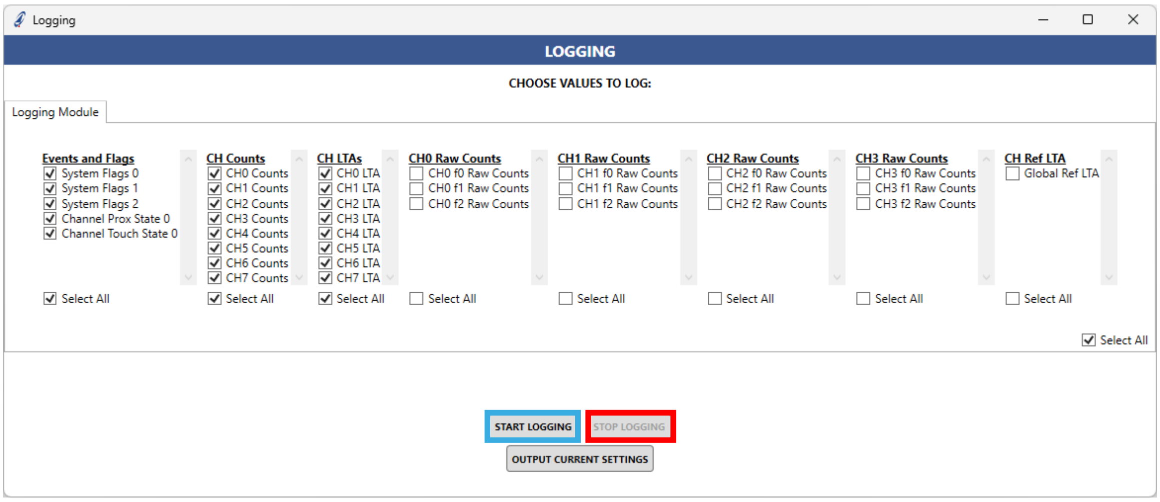


Figure 3.7: Logging Configuration Window

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 IQS7229A, 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.

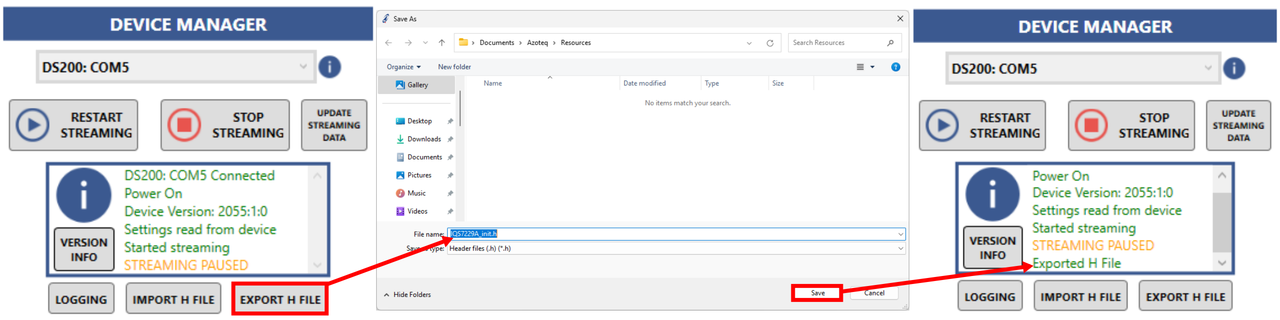


Figure 3.8: Exporting a Defined Configuration

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 using the 'ImportT H File' button. Additional information will be provided, to verify that the file was imported correctly:

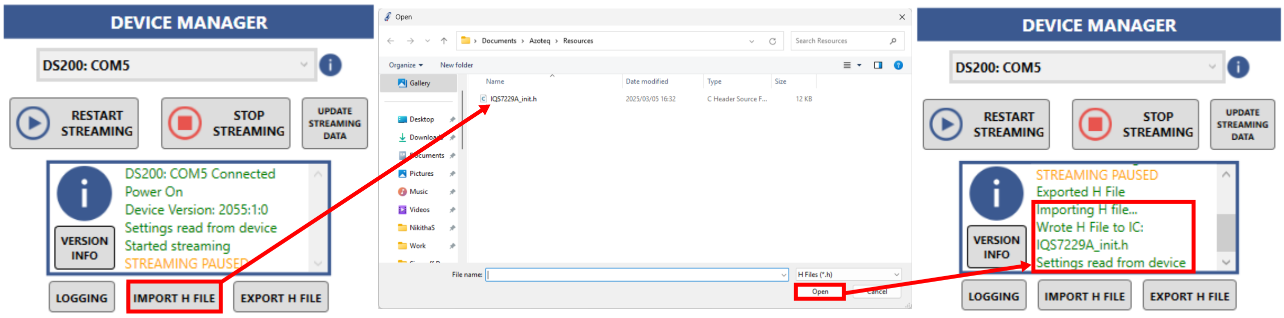


Figure 3.9: Importing a Predefined Configuration

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 IQS7229A’s reset flag by writing the **Acknowledge Reset** bit to the IC. This should be the fist 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 IQS7229A to perform a soft reset. This can be used to clear any configured settings back to their default values.

3.5.3 ATI All and Read

The “ATI All and Read” button writes the **Force ATI** command to the IQS7229A. 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 IQS7229A 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 IQS7229A'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.

- **System Flags 0**
  - ATI Active: The IQS7229A is currently calibrating the channels.
  - ATI Error: The IQS7229A failed to calibrate one or more channels correctly.
  - Reset: A reset event has occurred, and all settings have been reset to defaults.
  - Global Halt: Active when any channels' LTA value is halted by a prox or touch detection (requires global halt to be enabled).
- **Current Power Mode**: Indicates the current power mode of the device.
- **System Flags 1**:
  - Prox Event: The proximity state of one of the channels had changed.
  - Touch Event: The touch state of one of the channels had changed.
- **System Flags 2**
  - ATI Event: An ATI event occurred, and some calibration values may have been updated.
  - Power Event: The power mode has recently changed.
- **Touch-Prox Status**: These flags indicate the proximity and touch status of each channel.

Figure 3.11: Events Panel

4 System Settings

This section quickly explains some of the basic system settings and commands that are not specific to any sensor or UI. These settings can be accessed in the “User Settings” window, on the first tab.

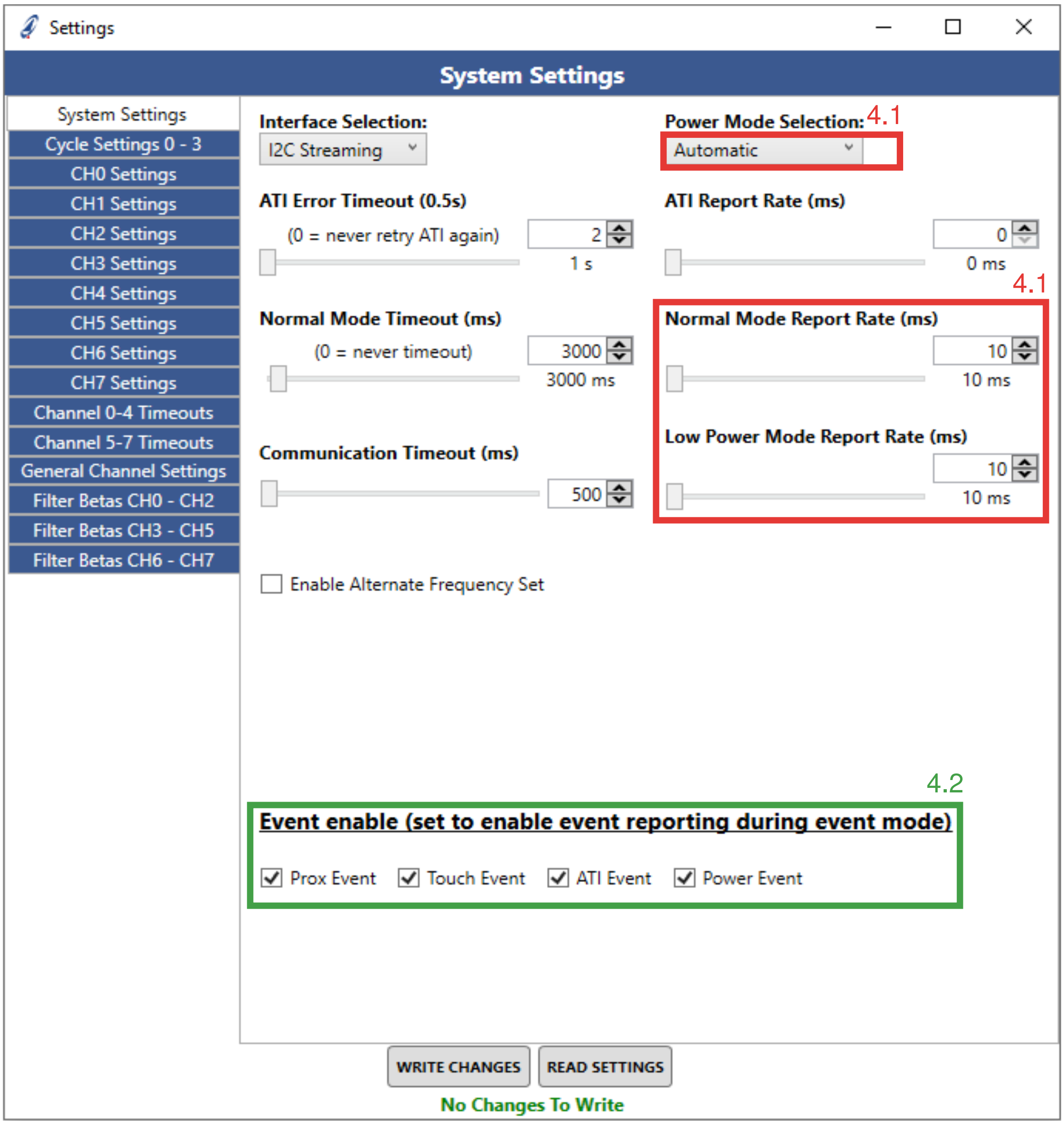


Figure 4.1: IQS7229A System Settings

4.1 Power Modes

The IQS7229A supports a number of different power modes. The current power mode of the IQS7229A can be set via the Power Modes dropdown menu in Figure 4.1.

- **Normal Power (NP)**: Flexible key scan rate.
- **Low Power (LP)**: Flexible key scan rate. Typically set to a slower rate than NP.
- **Automatic Power Modes**: Automatically switches between power modes.

In order to optimise power consumption and performance, power modes are "stepped" by default in order to move to power-efficient modes when no interaction has been detected for a certain (configurable) time known as the "mode timeout". The value for the power mode to never timeout (i.e., the current power mode will never progress to a lower power mode), is zero.

The sample rate of each power mode can be configured by changing the associated report rate. The report rate is the time between consecutive cycles, in milliseconds, where each cycle performs measurements on all channels. Higher power modes may sample faster at the cost of higher current consumption.

4.2 Event Mask

The event mask is used to enable or disable specific events, and is particularly useful in event mode, as disabled events will not open new communication windows. As an example, it is often useful to ignore ATI events. By clearing the ATI Event Mask bit, the IQS7229A will not open a communication window to report ATI events.

This only affects the behaviour of I^2C Event Mode — the associated event flags will still be set.

5 Cycle Setup

All the cycles of the IQS7229A are configured in self-capacitance mode and a conversion frequency of 500kHz as shown in Figure 5.1.

The IQS7229A device utilises CRx0 - CRx3 for ProxFusion® Engine A and CRx4 - CRx7 for ProxFusion® Engine B. Table 5.1 provides a full summary of the transmitter-receiver pin combinations of the different channels.

Note: The Tx corresponding to the CRx number needs to be selected to get the hardware correct for self-capacitive sensing.

Table 5.1: Channel receiver pins

Channels	Receiver
CH0	CRx0
CH1	CRx1
CH2	CRx2
CH3	CRx3
CH4	CRx4
CH5	CRx5
CH6	CRx6
CH7	CRx7

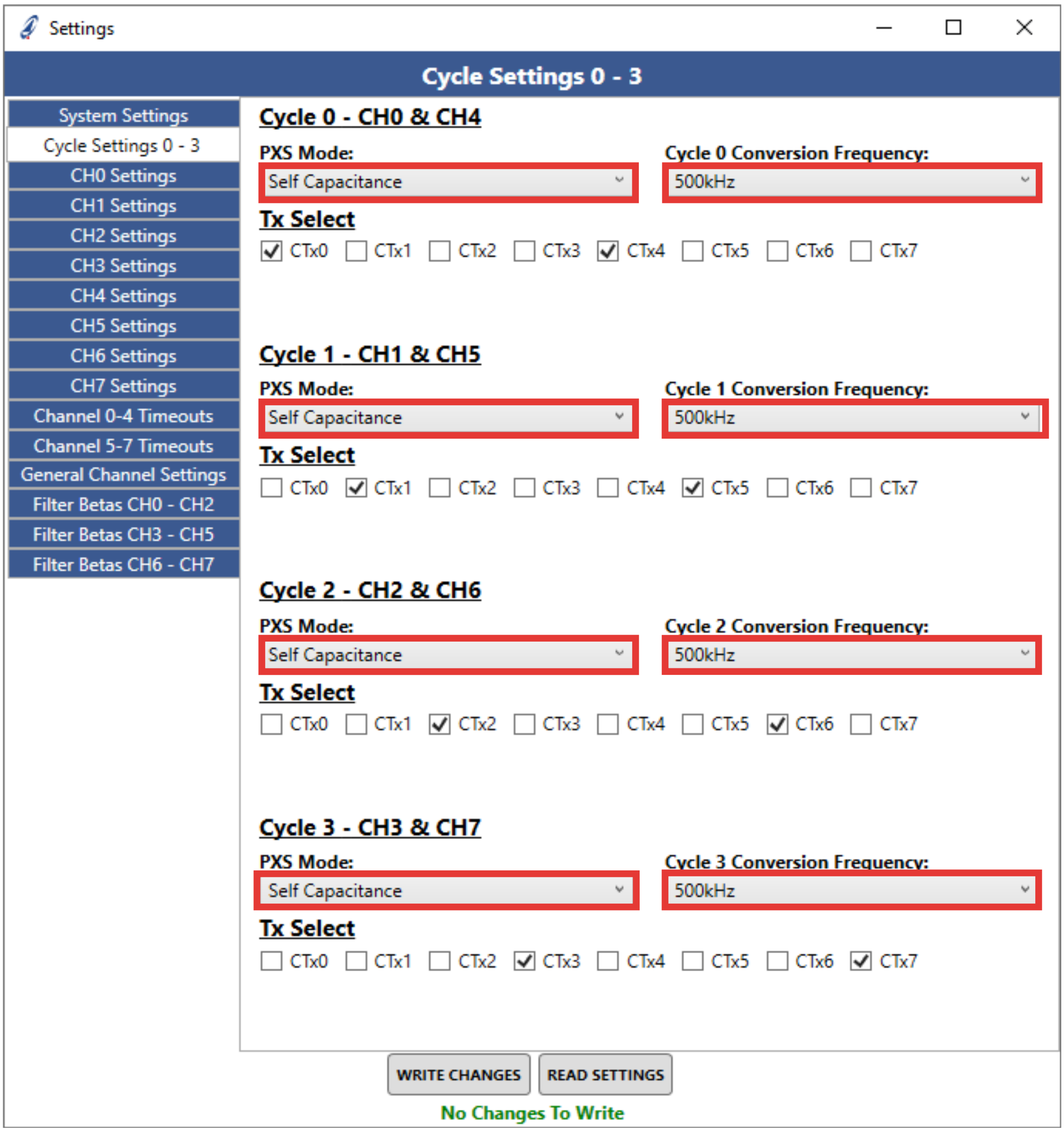


Figure 5.1: IQS7229A Cycle Setup

6 Button Setup

The configurable button settings as shown in Figure 6.1 below include proximity threshold, proximity enter and exit debounce, touch threshold and hysteresis, and ATI settings.

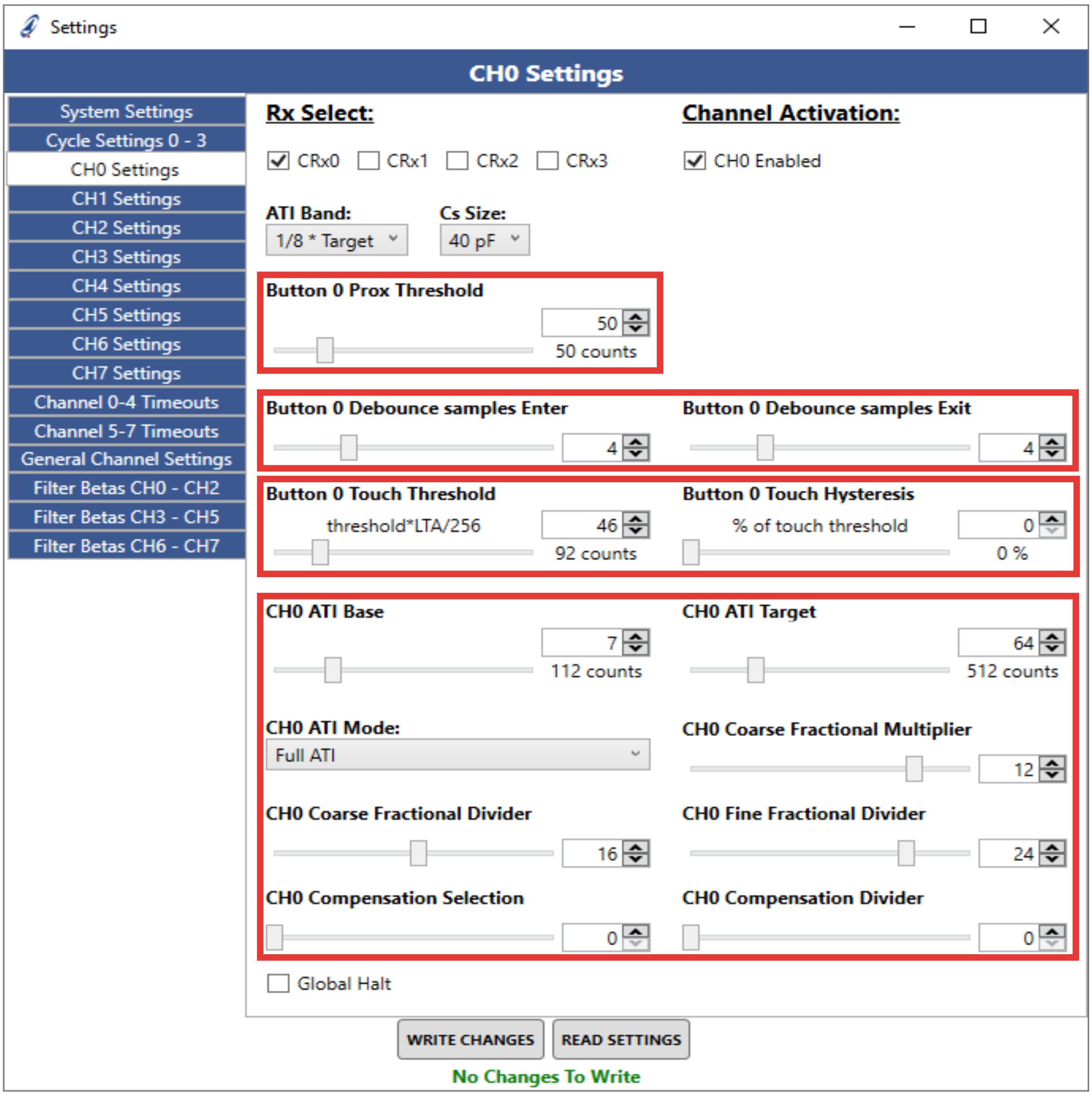


Figure 6.1: IQS7229A Button Setup

All the buttons have the same settings. Again, take note of the displayed values and units below each slider, as not all settings are shown in decimal units. Some settings are presented in fixed steps or percentages. The threshold can be calculated as shown in Equation 1.

$$\text{Button touch threshold} = \frac{\text{threshold decimal setting}}{256} \times \text{LTA} \tag{1}$$

The ATI is a sophisticated technology implemented in the new ProxSense® devices to allow optimal performance of the devices for a wide range of sensing electrode capacitances, without modification to external components. The ATI settings allow tuning of various parameters. Re-ATI will be triggered if certain conditions are met. One of the most important features of the Re-ATI is that it allows easy and fast recovery from an incorrect ATI, such as when performing ATI during user interaction with the sensor. The re-ATI boundary can be calculated as shown in Equation 2.

$$\text{Re-ATI Boundary} = \text{ATI Target} \pm \left(\frac{1}{8} \times \text{ATI Target}\right) \quad (2)$$

Other configurable settings as shown in Figures 6.2 and 6.3 include proximity event timeout, touch event timeout, and beta filters. After a prox or touch event timeout, a reseed of the LTA is forced. If the LTA is outside of the LTA ATI band a re-ATI event will occur if ATI is not disabled.

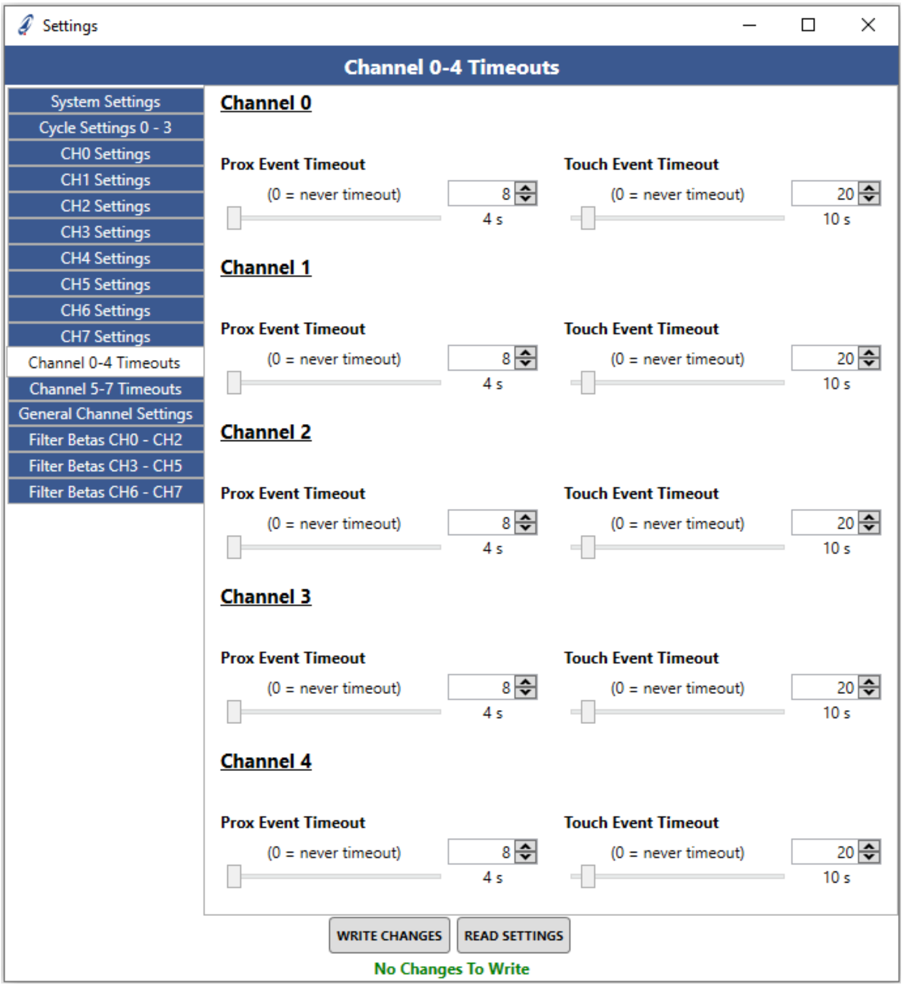


Figure 6.2: IQS7229A Button Timeout Setup

Figure 6.3: IQS7229A Button Beta Setup

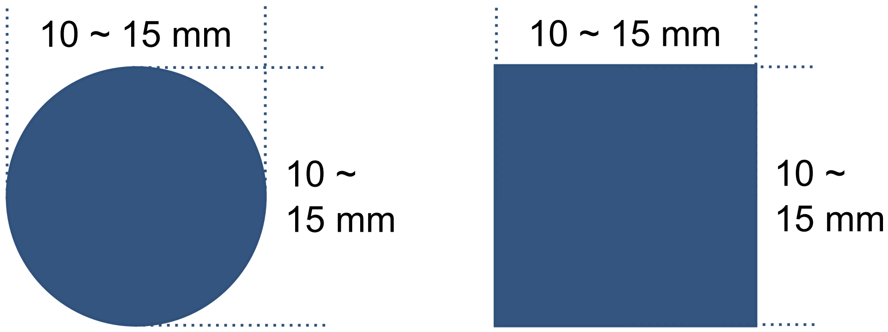
The default beta parameter options have been selected to accommodate the most common and generic applications. They are intended to filter according to specific power mode operations, thereby ensuring minimal noise while maintaining substantial response without lagging outputs. The parameters should also be adjusted to modify LTA amounts for slowly varying counts and to utilise the fast LTA beta for rapidly responding to count behaviour contrary to normal activations. These defaults are the recommended values and serve as a good starting point.

7 IQS7229A Conducted Immunity Design Guidelines

7.1 Introduction

The following basic design guidelines are suggested:

- Suggested button sizes and shapes:



- Suggested spacing between buttons:
  - Minimum 15 mm.
  - To minimise cross-coupling between electrodes.
- A solid GND pour under and around IC and connectors to PCB on top and bottom layers:
  - To provide a low-impedance path for high-frequency return currents.
  - To shunt common-mode noise currents to the main ground.
- Hatched-pour buttons with solid GND around buttons on the top layer:
  - To minimise parasitic capacitance and to improve sensor performance.
- Hatched GND Pour on the bottom layer that covers the whole area below and around the buttons:
  - To minimise parasitic capacitance along sensor traces and to improve sensor performance.

7.2 Examples of a Good Layout for Conducted Immunity when Using the IQS7229A IC

- Notice a fine mesh for the buttons on the top layer and a coarse mesh for the GND on the bottom layer.
- This optimises user coupling with the button while maximising the GND coverage without adding too much parasitic capacitance below the button, see Figure 7.1 below.

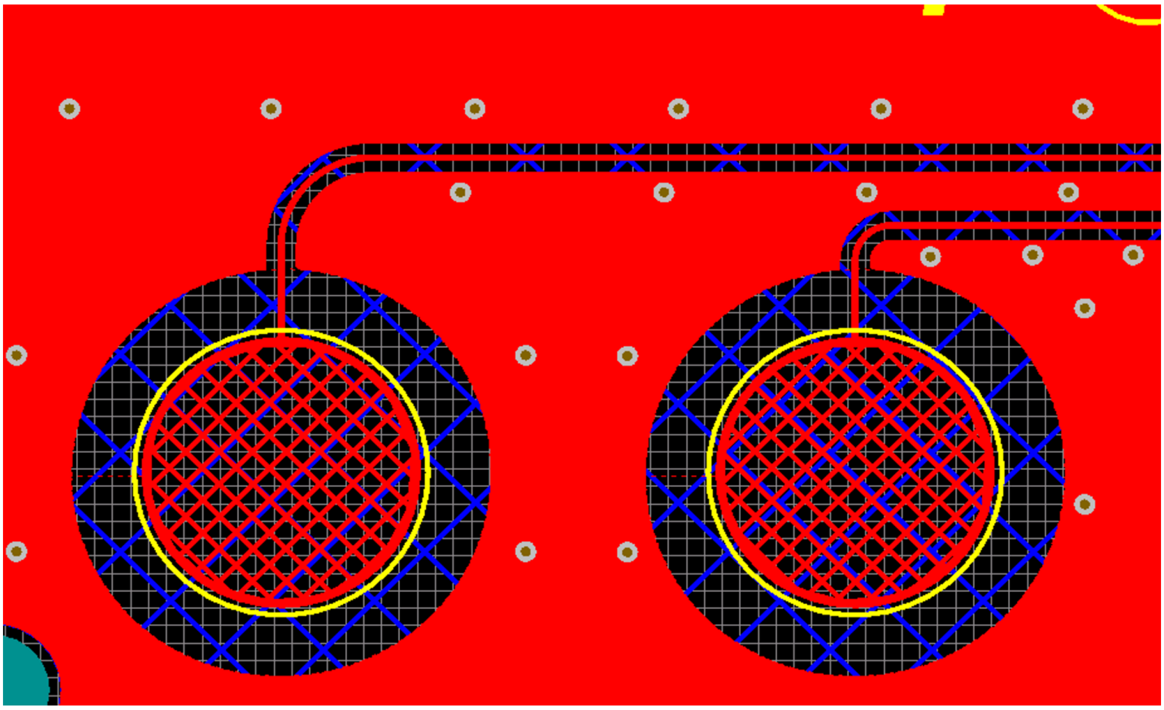


Figure 7.1: Top Layer in Red and Bottom Layer in Blue

7.3 Layout and Reference Schematic of a 6-Button Board Using the IQS7229A

7.3.1 Reference Schematic

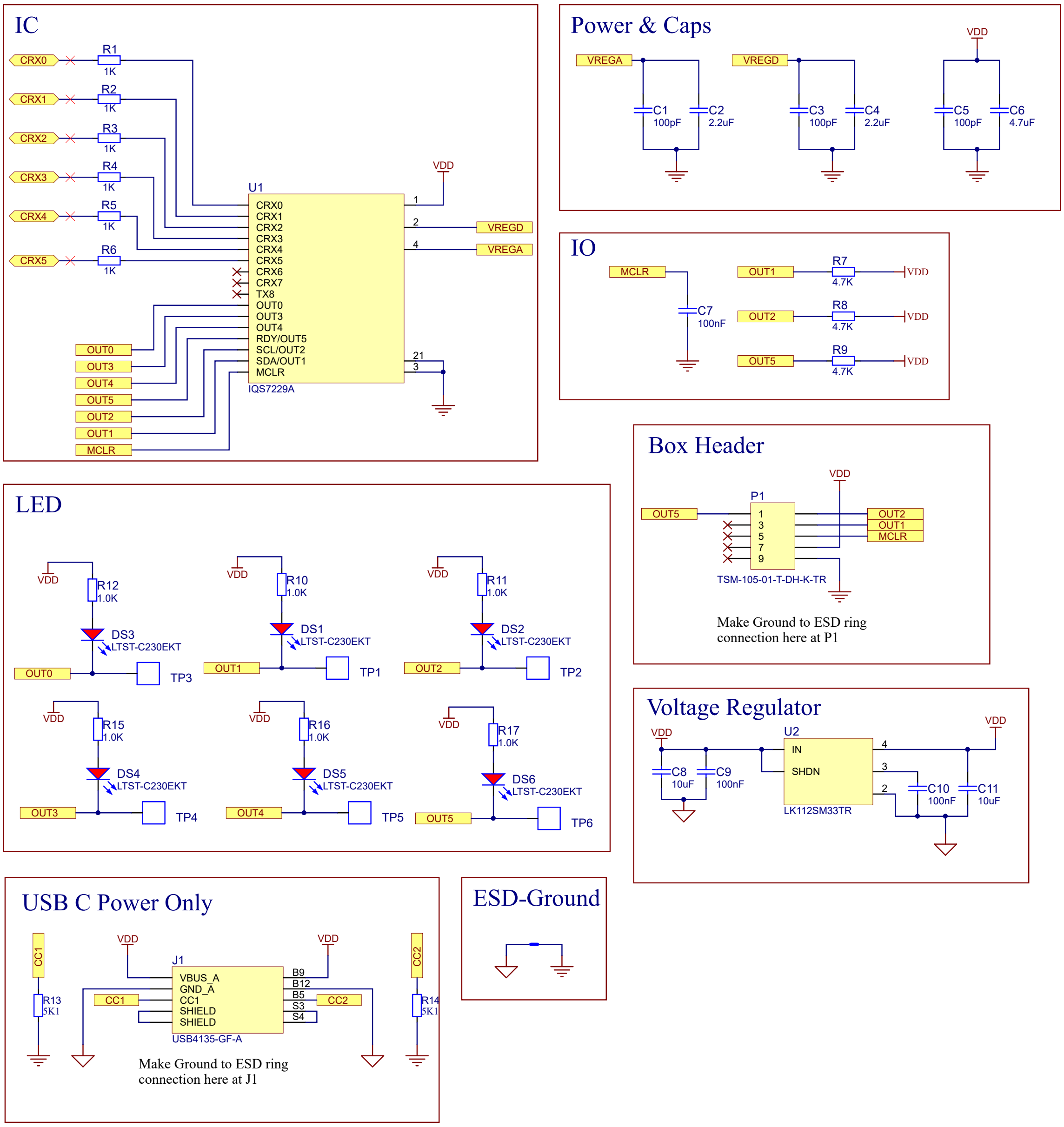


Figure 7.2: Reference Schematic of a 6-Button Board (AZP1376B2)

7.3.2 Top Assembly

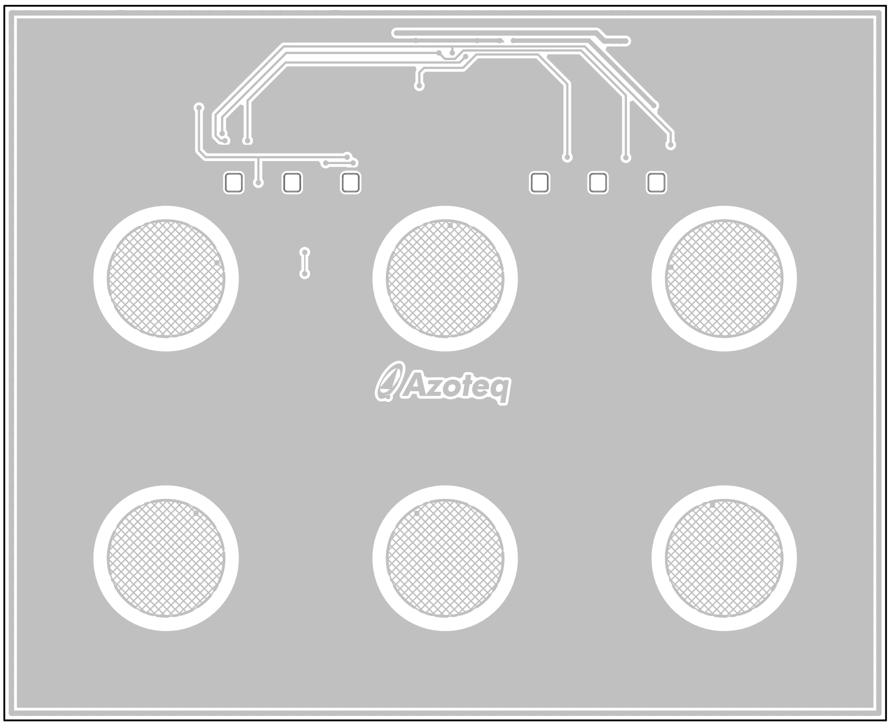


Figure 7.3: Top Layer of a 6-Button Board

7.3.3 Bottom Assembly

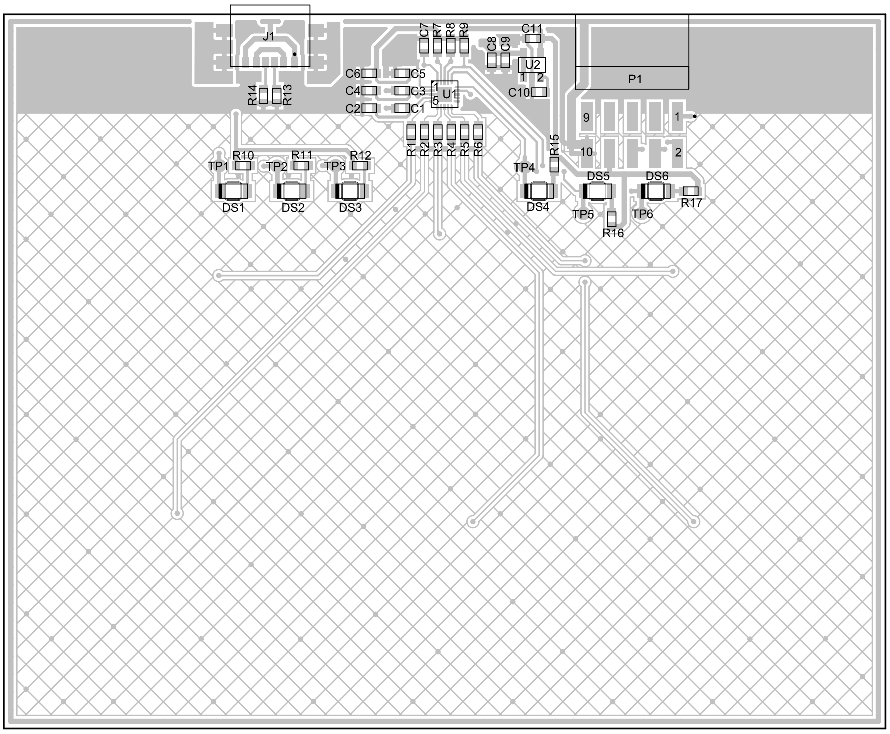


Figure 7.4: Bottom Layer of a 6-Button Board

7.4 Layout and Reference Schematic of a 8-Button Board Using the IQS7229A

7.4.1 Reference Schematic

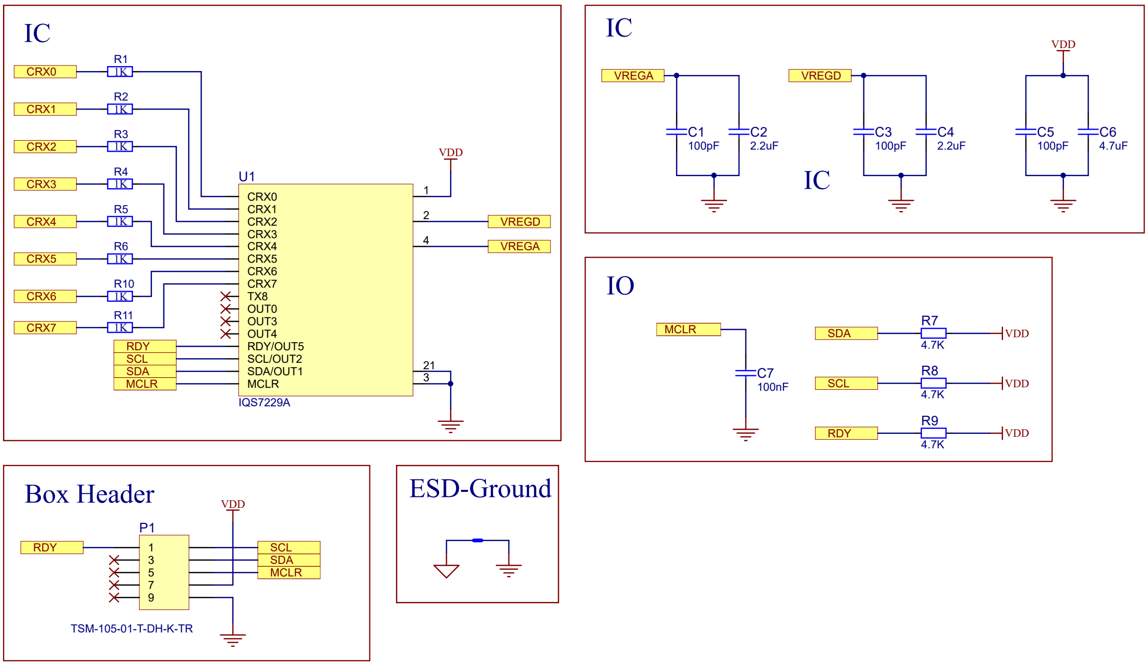


Figure 7.5: Reference Schematic of a 8-Button Board (AZP1376C1)

7.4.2 Top Assembly

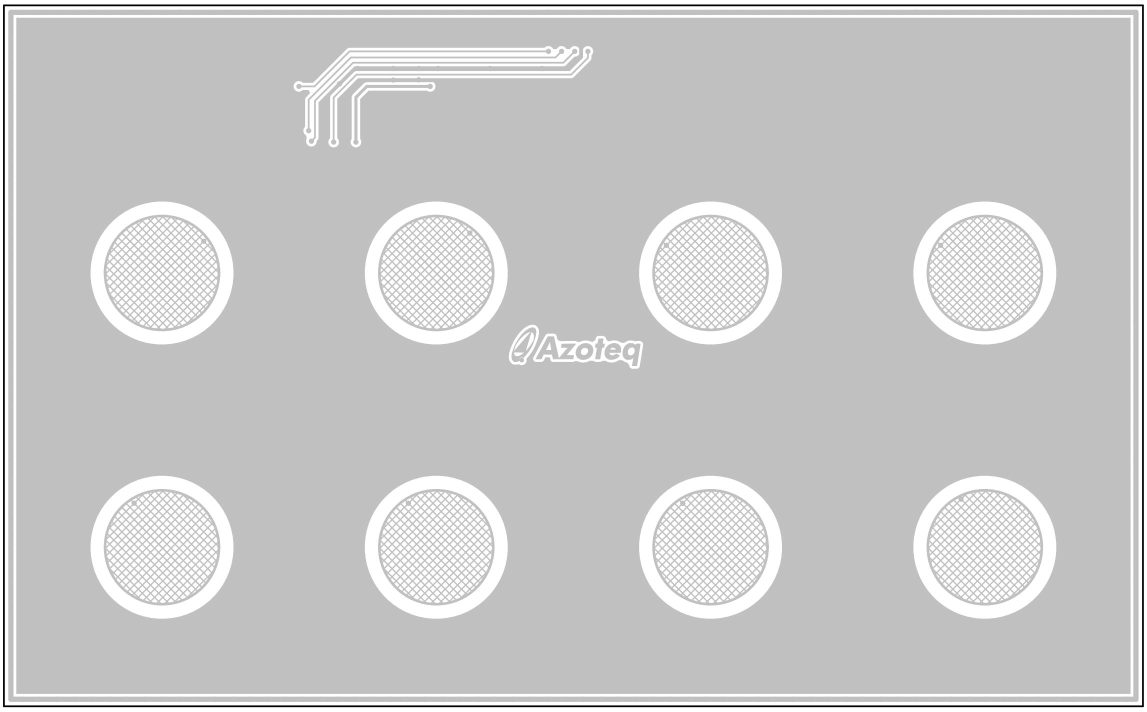


Figure 7.6: Top Layer of a 8-Button Board

7.4.3 Bottom Assembly

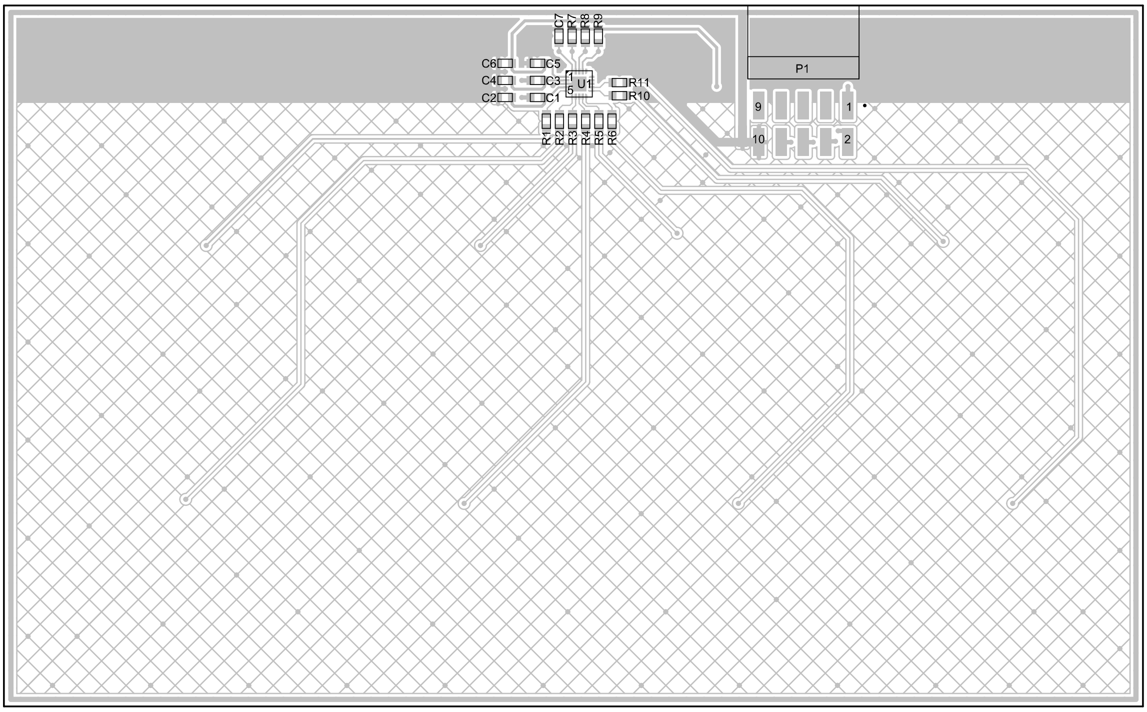


Figure 7.7: Bottom Layer of a 8-Button Board

8 Revision History

Release	Date	Comments
v1.0	March 2025	Initial document released
v1.0.1	March 2025	Fixed reference links in Section 2.7
v1.1	December 2025	Added Conducted Immunity Design Guidelines section (Section 7)

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