



IQS323 User Guide

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

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IQ Switch[®] ProxFusion[®] Series



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 4.1



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 4.2

- > 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.

IQ Switch[®] ProxFusion[®] Series



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:

Azoteq IQS323 v2.0.0	– 🗆 X
(i) About	IQS323 & Azoteq
	Choose product:
	IQS323-0xx IQS323-Axx

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 chip variant 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:



Azoteq IQS323 v2.0.0								-	
Download Ovisit Datasheet OProduct Page	Reset (j About 🕟	Back To Selection			IQS32	3-0x	x 🦉 A	zoteq
DEVICE MANAGER			AC	K RESET SOFT RESET ATI A	ALL		~	EVE	NTS VIEW LOG STATUS
DS200: COM5 🗸 🚺 A		BARS	SCOPE					ATI Active	ATI Error
START STREAMING STREAMIN	G 2000	1		Bar Chart			Ĭ	Device	e Reset
DS200: COM5 Connected	\sim	Counts						TOUCH - PF	OX EVENTS
	1500							CH0 Prox	CH0 Touch
		-						CH1 Prox	CH1 Touch
LOGGING IMPORT H FILE EXPORT H FIL	E	-					Prov	CH2 Prox	CH2 Touch
	1000						Touch	Current Po	wer Mode
SETTINGS							louch	NP	LP
WRITE CHANGES READ SETTINGS USER SET	TINGS								
	Q 500							ULP	Halt
 Sensor 0 Settings Sensor 1 Settings 	0x30	-						GEST	URES
Sensor 2 Settings	0x50	1						Тар	Swipe Pos
Channel 0 Settings	0x60 0x70 0							Curine New	Fliab Dee
Channel 2 Settings	0x80							Swipe Neg	Flick POS
Slider Configuration	0x90	. Channel	10	Channel 1				Flick Neg	Hold
Gesture Setup	0xA0	. 0		0		0		Event	Busy
Filter Betas	0xB0 Delta:	0		0		0		EVE	NTS
Power Mode & System Settings	0xC0 Dentil					-		Prov	Touch
				SLIDERS					
								Slider	Power
				0				А	ТІ

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.







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, I²C 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.



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Azoteq IQS323 v2.0.0					-	
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DEVICE MANAGER		ACK RESET SOFT RESET ATI ALL RES	EED		EVE	NTS VIEW LOG
	BARS SCOPE				ATI Active	ATI Error
STREAMING	2000	Bar Chart			Device	Reset
DS200: COMS Connected	Counts				TOUCH - PR	OX EVENTS
					CH0 Prox	CH0 Touch
·	1500				CH1 Prox	CH1 Touch
LOGGING IMPORT H FILE EXPORT H FILE				Prox	CH2 Prox	CH2 Touch
	1000			Touch	Current Po	wer Mode
SETTINGS				louen	NP	LP
WRITE CHANGES READ SETTINGS	500				IIIP	Halt
Sensor 0 Settings 0x30					02.	. Hait
Sensor 1 Settings 0x40					GEST	URES
Sensor 2 Settings 0x50	1				Тар	Swipe Pos
Channel 0 Settings 0x60	0				Swine Neg	Flick Pos
Channel 2 Settings 0x80	Channel 0	Channel 1	Channel 2		- mperineg	
Slider Configuration 0x90	Counts: 0	0	Channel 2		Flick Neg	Hold
Gesture Setup 0xA0	LTA: 0	0	0		Event	Busy
Filter Betas Ox80 Deven Mode & System Settings	Delta: 0	ő	ő	I	EVE	NTS
I2C Settings and Events Mask 0xD0	-				Prox	Touch
		SLIDERS				
					Slider	Power
		0			A	п

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.

DEVICE MANAGER	🖌 🖉 Azoteq Firmware Upgrader	- 0 X
DS200: COM5 UPDATE AVAILABL	CURRENTLY CONNECTED: AVAILABLE UPGRADE:	Azoteq DS200 v1.0.32-b DS200 v1.0.36-b
DS200: COM5 Connected	CONNECTED DEVICE: DS200 v1.0.32-b	×
SETTINGS WRITE CHANGES READ SETTINGS USER SETTING O	S START UPGRADE	

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
- > I²C address
- > Device version information
- > Settings and streaming confirmations or errors, as applicable



Note that the IQS323 product can be ordered with different I^2C 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.

ACK RESET	SOFT RESET	ATI ALL	RESEED				
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.



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Download Strait Product Page	keset ayout (i) Abo	ut D Back To Selection		IQS32	23-0x	x 🦉 A	zoteq
DEVICE MANAGER			ACK RESET SOFT RESET ATI ALL	RESEED	·	EVE DEVICE	NTS VIEW LOG
DS200: COM5 (1)	BARS	SCOPE			~	ATI Active	ATI Error
PAUSE STREAMING STREAMING	2000		Bar Chart			Device	e Reset
Trying default I2C Address : 0x44 I2C Address: 0x44 Diviso Variant 1106-12	Legen	d unts				TOUCH - PF	CH0 Touch
VERSION INFO Settings read from device Started streaming	1500					CH1 Prox	CH1 Touch
LOGGING IMPORT H FILE EXPORT H FILE	_				Prox	CH2 Prox	CH2 Touch
SETTINGS	1000				Touch	Current Po	ower Mode
WRITE CHANGES READ SETTINGS USER SETTING	s					NP	LP
No Changes To Write	2 500					ULP	Halt
 Sensor 1 Settings 0x40 					_	GEST	URES
Sensor 2 Settings Ox50 Channel 0 Settings Ox60						Тар	Swipe Pos
Channel 1 Settings 0x70	0					Swipe Neg	Flick Pos
Channel 2 Settings 0x80		Channel 0	Channel 1	Channel 2		Flick Neg	Hold
Gesture Setup 0xA0	Counts:	387	387	388		Event	Busy
Filter Betas 0x80	LíA: Doltai	388	388	389		EVE	NTS
Power Mode & System Settings 0xC0 D I2C Settings and Events Mask 0xC0	Jena:	-1	-1	-1		Prov	Touch
The Settings and Events Mask 0000			SLIDERS			1100	iouch
						Slider	Power
			0			A	ті

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.



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.



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DEVICE MANAGER	ACK RESET SOFT RESET ATT ALL RESEED	EVE	NTS VIEW LOG STATUS
	BARS SCOPE	ATI Active	ATI Error
Settings read from device		Device TOUCH - PR	OX EVENTS
Demo loading VERSION INFO VERSION INFO	SAVE SCOPE CAPTURE	CH0 Prox	CH0 Touch
LOGGING IMPORT H FILE EXPORT H FILE	Amount Of Points on X-Asis:	CH2 Prox	CH2 Touch
SETTINGS	1000 RESET X AXIS RESET Y AXIS	NP	LP
No Changes To Write Q		ULP	Halt
Sensor 1 Settings 0x40	500 CHI LTA	GEST	URES
Channel 0 Settings 0x50		Тар	Swipe Pos
Channel 1 Settings 0x70		Swipe Neg	Flick Pos
Channel 2 Settings Ox80 Slider Configuration		Flick Neg	Hold
Gesture Setup OxA0		Event	Busy
Filter Betas 0x80	5600 5650 5700 5750 5800 5850 5900 5950 6000 6050	EVE	NTS
Power mode & System Settings 0xC0 I2C Settings and Events Mask 0xD0		Prox	Touch
	SLIDERS	Slider	Power
	0	A	п

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.

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Download Visit Datasheet Product Page Reset	t i About 🕑 Back To Selection	23-0xx	🖉 Azoteq
DEVICE MANAGER DS200: COM5	ACK RESET SOFT RESET ATTALL RESEED BARS SCOPE	A ITA	EVENTS VIEW LOG DEVICE STATUS Active ATI Error
RESTART STREAMING STREAMING	2000 Scope		Device Reset
Started streaming Demo loading Wrote H File to IC: buttons.h ATI Done		CH0	PROX EVENTS
LOGGING IMPORT H FILE EXPORT H FILE	1500 - Amount	t Of Points on X-Axis: CH2	Prox CH1 Touch Prox CH2 Touch
SETTINGS		RESET X AXIS	iurrent Power Mode
No Changes To Write Q Sensor 0 Settings occo		CH0 Counts CH1 Counts CH2 Counts CH0 LTA	ILP Halt
Sensor 2 Settings Ox40 Sensor 2 Settings Ox40 Ox40	500	CH2 LTA CH2 LTA Select All	ap Swipe Pos
Channel 1 Settings 0x70 Channel 2 Settings 0x80 Silder Configuration 0x30 Control Software 0x40		Swip Flick	e Neg Flick Pos x Neg Hold
Filter Betas OxB0 Power Mode & System Settings OxC0	21700 21750 21800 21850 21900 21950 22000 22050 22100 22150	Ev	EVENTS
I2C Settings and Events Mask 0xD0	SLIDERS	- Pr	rox Touch
		Sli	der Power
	0		ATI

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.



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SCOPE CAPTU	RE		gr Jeane Has ← → → ↑ ▲ Documents → Azoteq → Resources → ♂ Search Resources ♪	
Available Range: 1522-2021 (500 datapoints)			Organize ▼ New folder Image: Size R Galley Name Date modified Type No items match your search.	•
Save entire range			Desktop Downloads	
Minimum:	_	1522 🜩	Pictures Pictures Pictures Pictures Pictures Pictu	
Maximum:		2021 🚭	File name: [05523-0n_scopecepture.cs)	~
SAVE TO CSV			Hide Folders Save Cancel)

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.

DEVICE MANAGER						
DS200: CO	M5				~	
RESTART STREAMING STREAMING						DATE AMING ATA
VERSION	Started streaming Demo loading Wrote H File to IC: buttons.h ATI Done Settings read from device STREAMING PAUSED					
LOGGING	ІМРО	ORT H FI	LE	XPORT H	FILE	

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.



				-	- 0	×	
LOGGING							
		CHOOSE VAL	UES TO LOG:				
Logging Module	Logging Module						
Events and Flags System Flags 0 CH Prox and Touch State Slider gestures	H Counts ^ CH0 Counts ^ CH1 Counts ^ CH2 Counts ^	CH LTAs ✓ CH0 LTA ✓ CH1 LTA ✓ CH2 LTA ✓	CH Activation LTA CH0 Activation LTA CH1 Activation LTA CH2 Activation LTA	CH Delta Snapshots ✓ CH0 Delta Snapshot ✓ CH1 Delta Snapshot ✓ CH2 Delta Snapshot	<u>Slider</u> √ Slider		
Select All	Select All	Select All	Select All	Select All	✓ Select	All	
					⊻ 5	elect All	
START LOGGING STOP LOGGING							
OUTPUT CURRENT SETTINGS							

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.

ACK RESET SOFT RESET ATI ALL RESEE	D
------------------------------------	---

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 had changed.
 - Touch: The touch state of one of the channels had 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:
 - Тар
 - Hold
 - Swipe
 - Flick



Figure 3.11: Events Panel





4 Reference Design

4.1 IQS323EVO1

4.1.1 General-Purpose Stamp Module









4.2 IQS323EVO2

4.2.1 Touch Slider Module



Figure 4.2: Touch Slider Reference Schematic



4.2.2 Touch Buttons Module



Figure 4.3: Touch Buttons Reference Schematic



4.2.3 Inductive Sensing Module







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