

BUMBLEBEE
INSTRUMENTS

SCOPE - X

Electronics at Home

User Manual

Complete Laboratory Manual

- Bipolar Supply $\pm 12V$ added
- Offset and Gain adjust simplified
- Additional breadboard space

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1 Introduction

Overview: The Scope-X development board from Bumblebee Instruments provides a comprehensive platform for understanding basic analog circuit design principles through hands-on experimentation and analysis.

This manual serves as both an instructional guide and reference document for the Scope-X. Designed by Bumblebee Instruments, the kit provides students and engineers with practical experience in analog circuit design, analysis, and implementation using industry-standard components and methodologies.

The laboratory exercises contained within this manual progress from fundamental operational amplifier concepts to advanced signal processing techniques, ensuring a thorough understanding of analog system design principles.

1.2 Kit Components

Table 1: Hardware Components Overview

Component	Description	Quantity
Scope-X Main Board	Analog signal acquisition and processing unit	1
Power Cable	Supplies regulated power to the main board	1
USB Interface Cable	Enables communication with the PC	1

2 System Setup and Configuration

Important: Ensure all power connections are verified before energizing the system. Observe proper ESD handling procedures when working with electronic components.

2.1 Initial Setup Procedure

1. Carefully unpack all kit components and verify contents against the packing list
2. Install the Scope-X software package on your computer
3. Connect the main board to your computer using the provided USB cable
4. Connect the power cable to the board and verify LED indicators

System Requirements

- Operating System: Windows 10/11

2.1.1 Install Application and Drivers

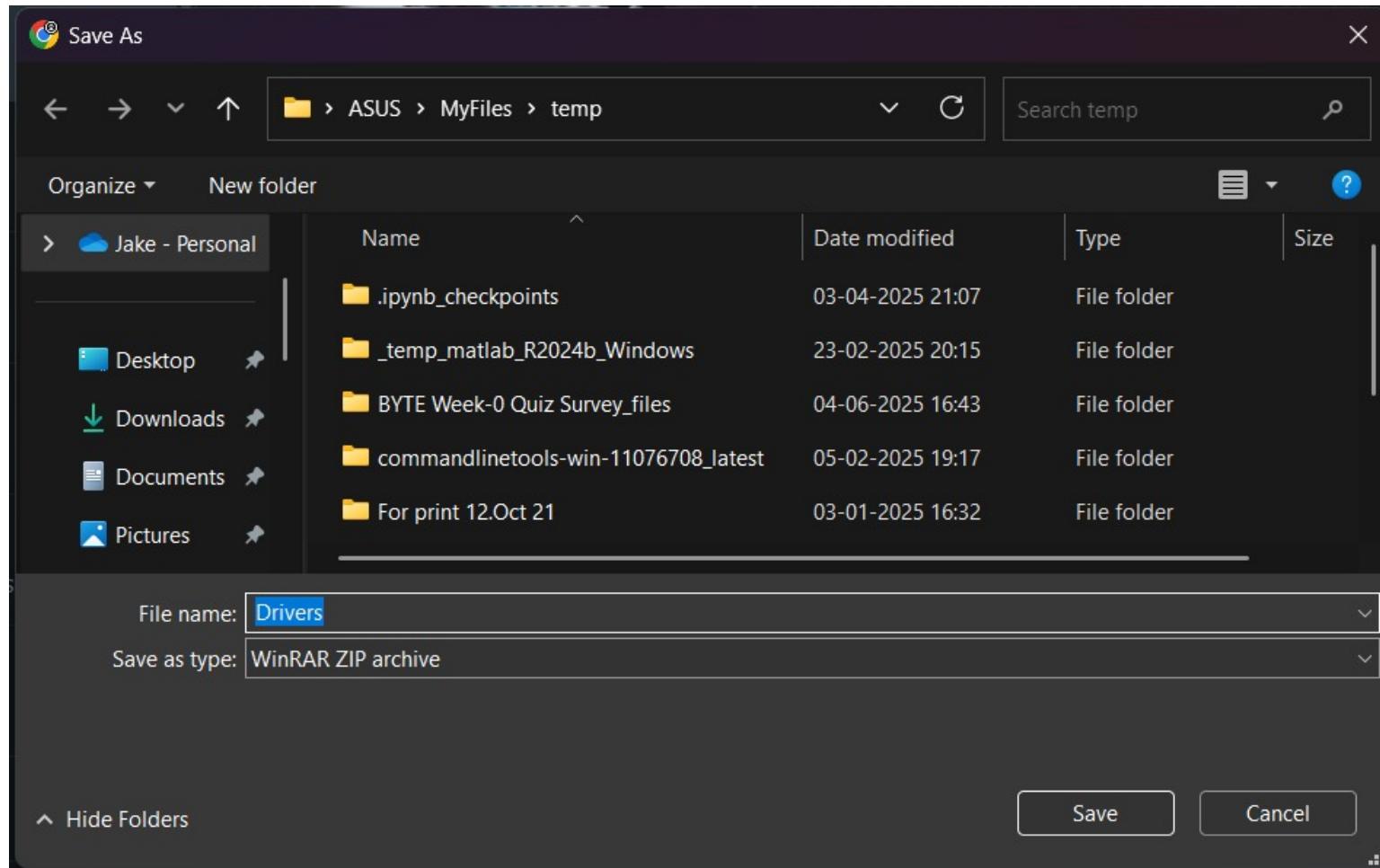


Figure 1: Install the .exe and the Drivers.zip file in your preferred directory.

2.1.2 Open Executable



Figure 2: Open the .exe file and select 'Run anyway' if prompted.

2.1.3 Connect Scopex and Find Device

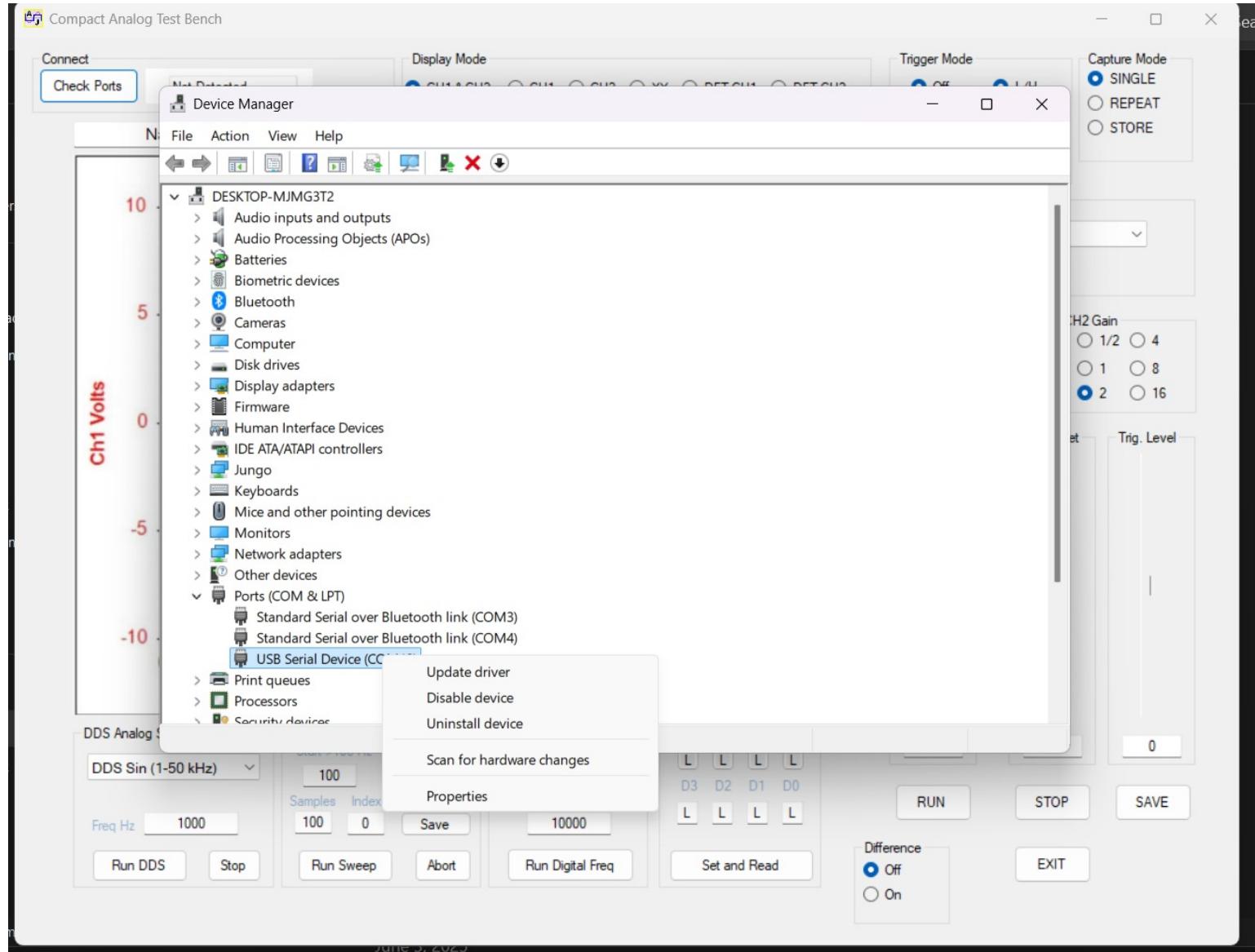


Figure 3: Connect Scopex and open Device Manager. Locate 'USB Serial Device' under COM Ports.

2.1.4 Update Driver

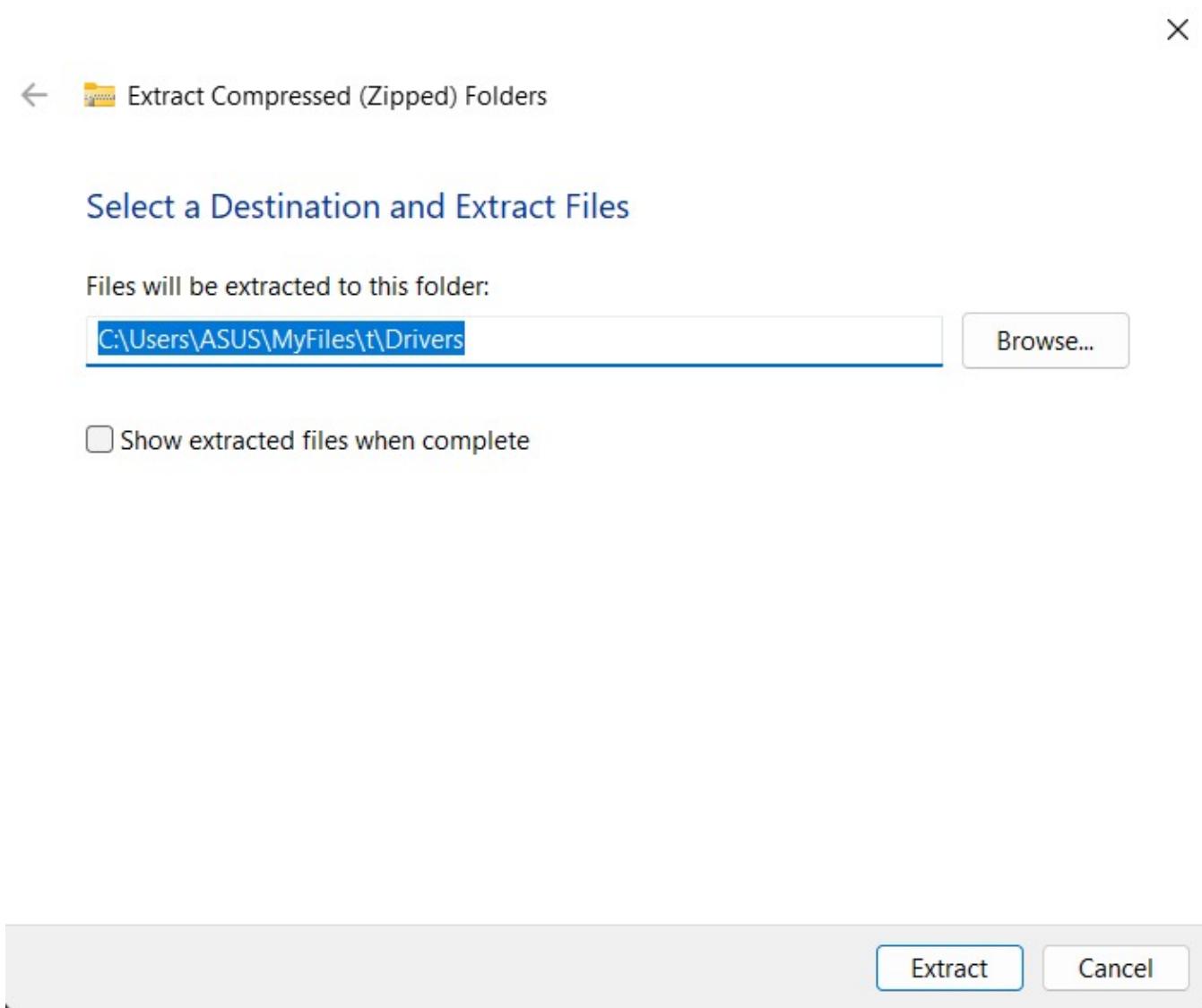


Figure 4: Right-click 'USB Serial Device', select 'Update Driver', and choose the driver folder.

2.1.5 Install Driver

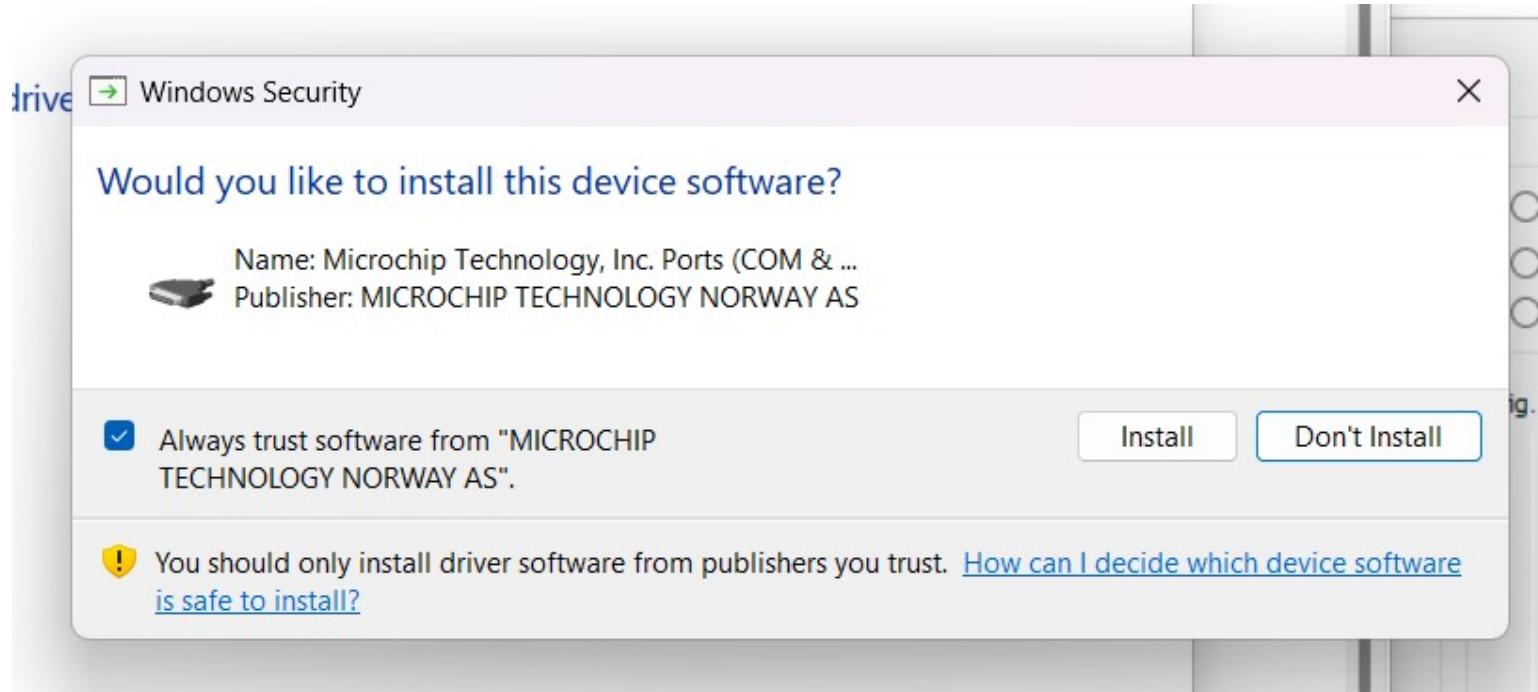


Figure 5: Install the drivers as shown.

2.1.6 Verify COM Port Recognition

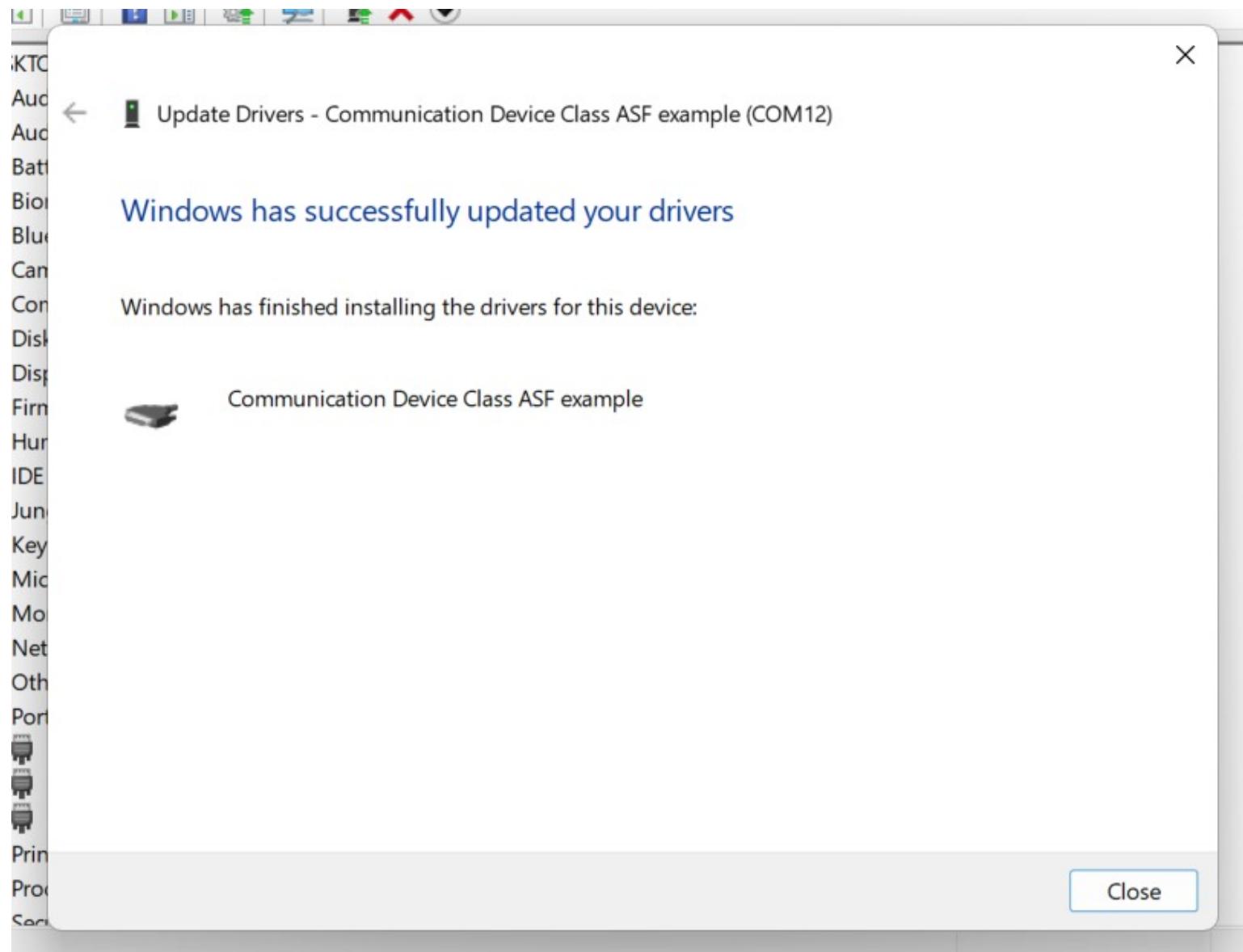


Figure 6: Once installed, verify that Scopex is recognized under the correct COM Port.

2.1.7 Launch GUI and Check Ports

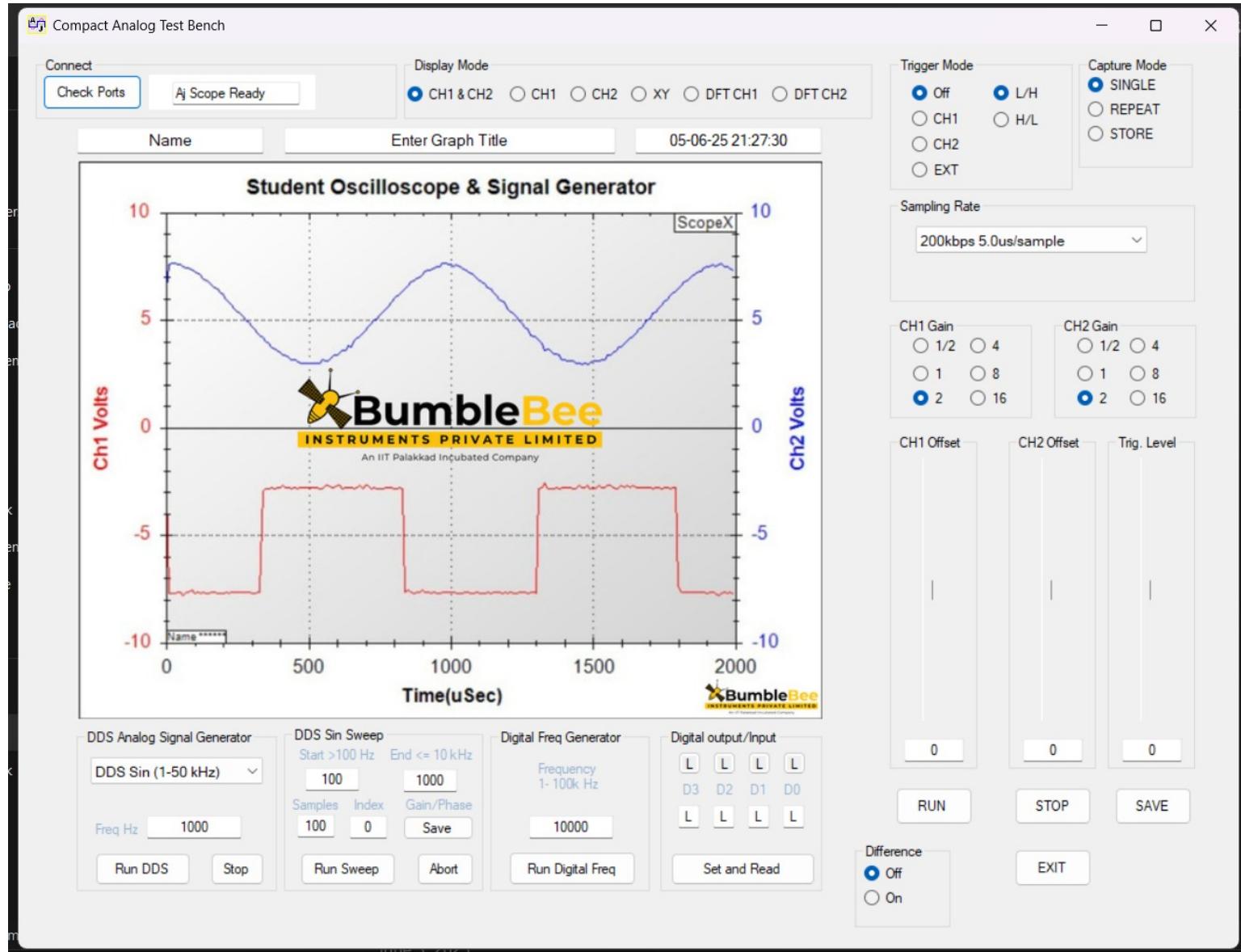


Figure 7: Launch the GUI and click 'Check Ports'. The device is now successfully connected.

3 Hardware Architecture

3.1 Main Board Overview

The Scope-X main board features a modular architecture optimized for educational use and rapid prototyping.

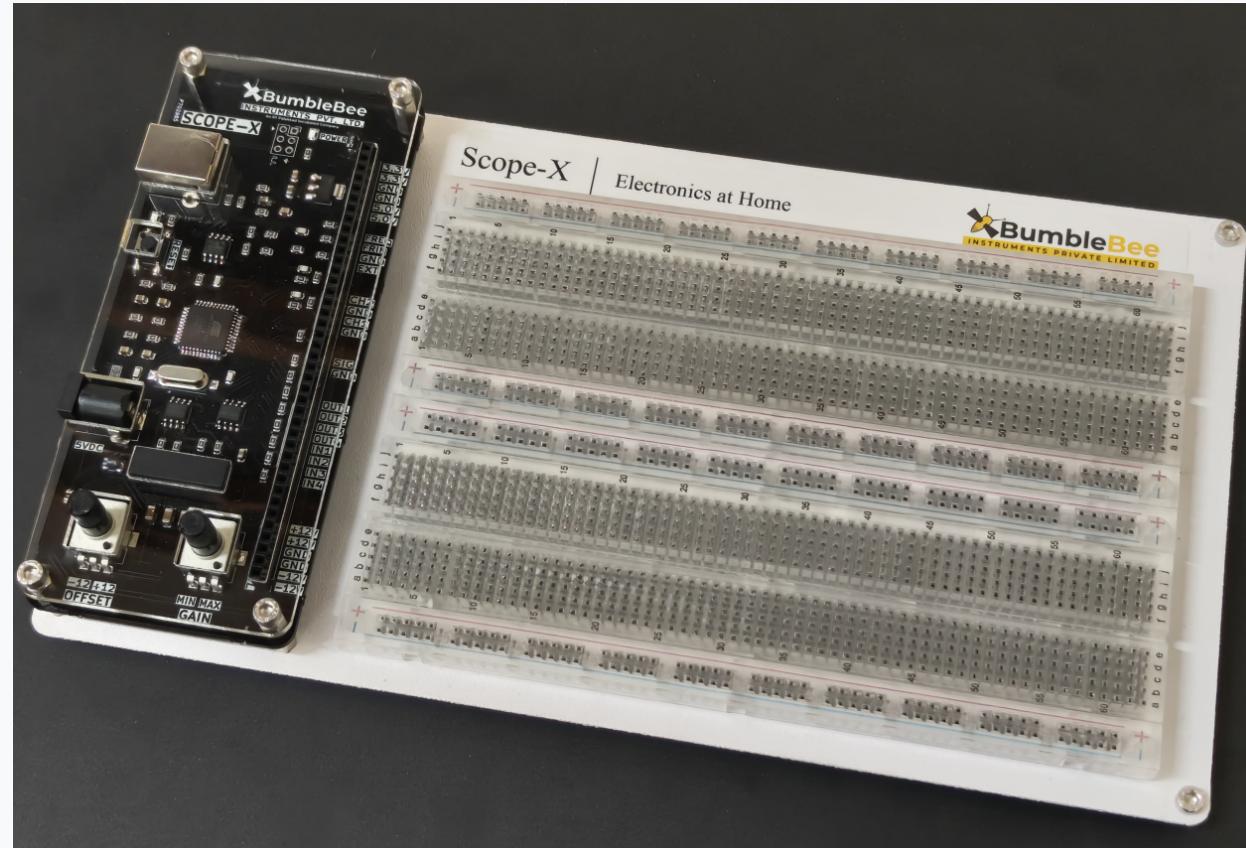


Figure 8: Scope-X Main Board

3.2 Board Features

Table 2: Functions

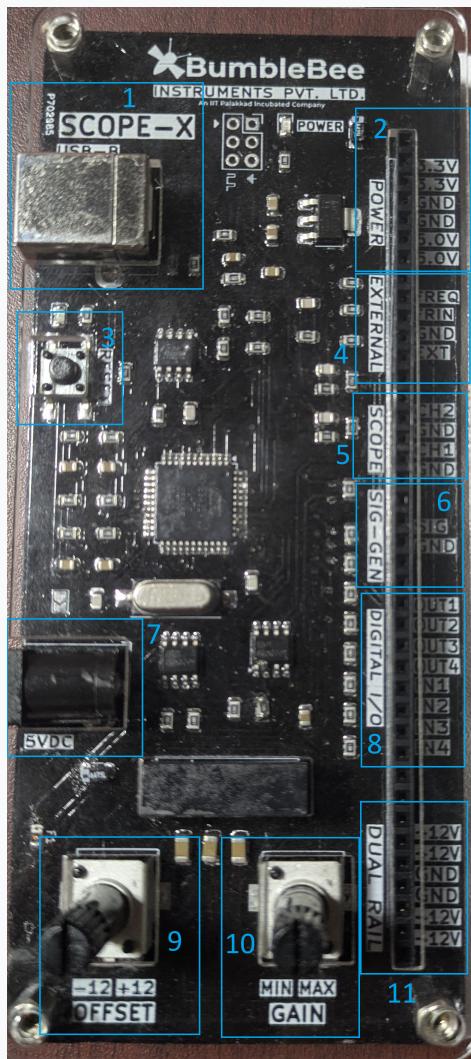


Figure 9: Scope-X Main Board

Features	Usage
1 USB-B	USB adapter to connect with the PC
2 Power	Acts as power supply
3 Reset	Resets the Board
4 External	Other External pins
5 Scope	Oscilloscope with two channels
6 Signal generator	Generates signal that is selected in the GUI
7 5VDC	Power supply to the Board
8 Digital I/O	4 input and output pins to read/generate digital signals
9 Offset	Adjustable Offset between -12V and 12 V
10 Min Max Gain	Adjusts Gain
11 Dual Rail	Bipolar Power supply

4 GUI Software functions

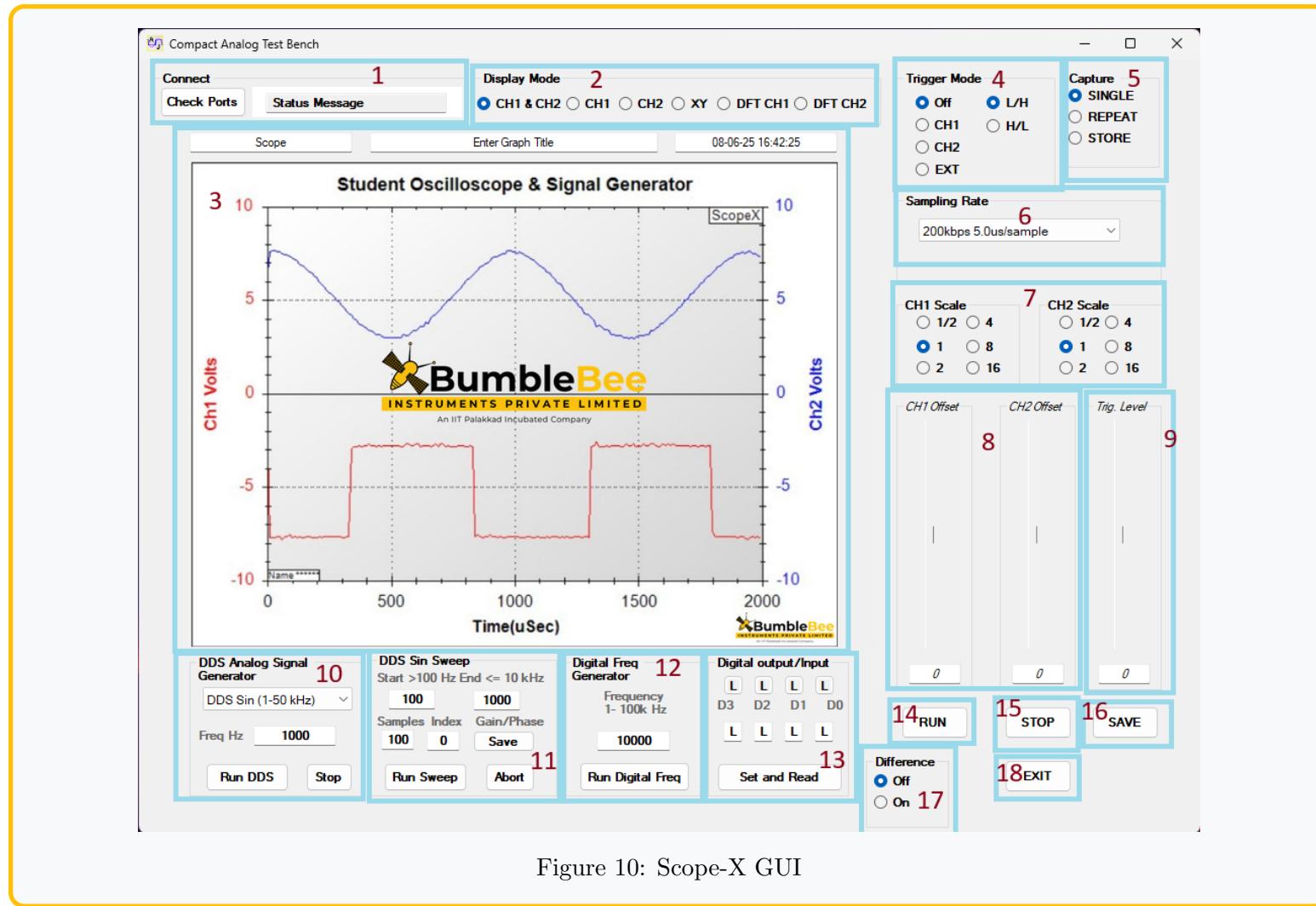


Figure 10: Scope-X GUI

Index	Function
1	Connect - Check Ports – Click Shows the connection Status, Ready message shows when connected
2	Display Mode - For the Oscilloscope Mode, X-Y Mode or DFT Mode selects channel to be displayed (CH1 & CH2, CH1, CH2, XY, DFT CH1, DFT CH2)
3	Main Oscilloscope Display - Shows Student Oscilloscope & Signal Generator with waveform traces. Shows individual point values with mouse pointer for easy readout. Right Click permits Save image/Print/Zoom functions
4	Trigger Mode - Selects the Oscilloscope Trigger mode (Off, CH1, CH2, EXT) and Trigger slope (L/H (Low to High), H/L (High to Low))
5	Capture - Single – Single shot mode (useful for capturing single events with trigger). Repeat – Continuous running with repeated display. Store – Useful for capturing additional traces (run single then store)
6	Sampling Rate - Selects Sampling rate / Time per sample (200 samples are displayed). Display time scale will change appropriately (200kbps 5.0us/sample shown)
7	CH1,CH2 Scale - Sets the Gain for CH1,CH2 (1/2, 1, 2 with corresponding scale values 4, 8, 16). Display amplitude scale will change appropriately
8	CH1,CH2 Offset - CH1,CH2 Offset (useful for centering the display around Zero to display small signals with large offset at higher gain values)
9	Trig. Level - Set the trigger threshold in CH1/CH2 trigger modes. (If not triggered display will show Busy)
10	DDS Analog Signal Generator - DDS-Analog signal generator. Select frequency (1000 Hz shown) and waveform type (DDS Sin 1-50 Hz) and Run. For Arbitrary waves read a single 256 column .csv file with data value 5-250
11	DDS Sin Sweep - Generate Bode-Plots, enter the start >100 Hz End <= 10 kHz frequencies, number of samples (100, 1000) displays sample by sample amplitude/phase and finally shows the Bode-Plot. Save the Bode-Plot as a .csv file

Index	Function
12	Digital Freq Generator - Enter any frequency value 1-100k Hz (10000 shown) and Run to get a 3.3V square-wave / inverted square wave at the digital frequency out pins
13	Digital output/Input - Set-up the individual digital-out bits using the top boxes (L L L L D3 D2 D1 D0) and "Set and Read" shows the individual digital-in bits
14	RUN - Starts the data capture (shows Busy while running or not triggered)
15	STOP - Stops the data capture
16	SAVE - Once data is captured and stopped, Save button creates a .csv file of Time Stamp-CH1 data- Ch2 data – Frequency – CH1 DFT – CH2 DFT (this data can be used for further processing)
17	Difference - Shows difference of CH1 and CH2 signals
18	EXIT - Exits the GUI application

5 Troubleshooting and Maintenance

5.1 Common Issues and Solutions

Table 4: Troubleshooting Guide

Problem	Solution
No power indication on main board	Verify power cable connections
Board not recognized	Make sure the drivers are installed and the Scope-X board is recognized as Communication Class Device ASF Example in Device Manager
GUI malfunctioning	In case of any malfunctioning, please restart the application.