



# **RoboKit User Guide**

## Windows Application

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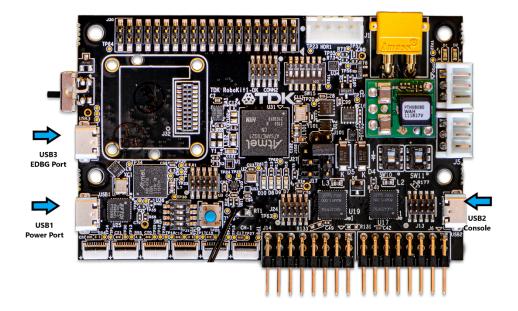


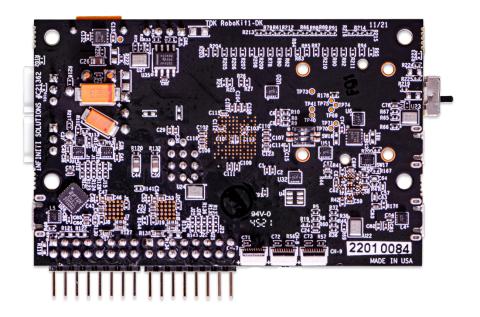
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## **1** ROBOKIT1 MODULE

This document provides an overview of how to utilize the RoboKit1 app for data capture and logging. Figure 1 and Figure 2 show the top and bottom views of a RoboKit1 module. This module includes a Pressure sensor, IMU, Temperature sensor, Magnetometer, Audio, Microphone, Motor controller, and Battery connector on board. It also provides the facility to connect 9 Chirp sensors. USB1 is used for power supply and the interface with the board. USB2 is used as port for debug text messages and USB3 is to load the Firmware image.







## 2 INSTALLING & RUNNING ROBOKIT

#### 2.1 INSTALLING FROM LOCAL DIRECTORY

Follow the process below to install the application from the local directory:

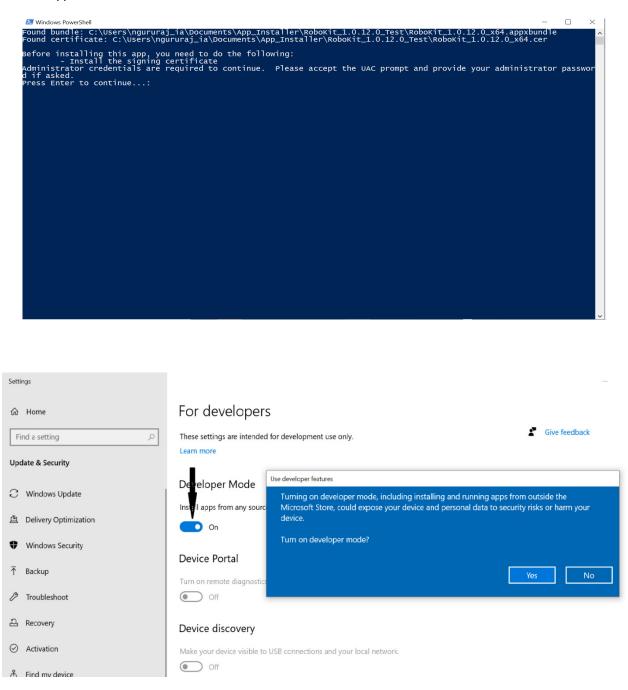
1. Right click on the "install" file and click on "Run with PowerShell"

Open		∪sers > ngururaj_ia > Doc	uments > App_Installer >	RoboKit_1.0.12.0	Test >		~	U	🔎 Search R	boKit_1
Run with PowerShell		Date modified	Type	Size						
Edit		12/22/2021 3:53 AM	File folder							
Share with Skype		12/22/2021 3:53 AM	File folder							
Scan for threats		12/22/2021 3:53 AM	File folder							
Classify and protect		11/11/2021 1:55 PM	Windows PowerShell	37 KB						
<ul> <li>Move to OneDrive</li> </ul>		11/11/2021 1:55 PM	Windows PowerShell							
7-Zip	~ ~	12/15/2021 10:12 AM	APPXBUNDLE File	6,613 KB						
CRC SHA	~	12/15/2021 10:12 AM	APPXSYM File	8,133 KB						
Edit with Notepad++		12/15/2021 10:12 AM	Security Certificate	1 KB						
Process Directory										
Encrypt for sharing										
Open Dell Encryption										
🖒 Share										
Open with										
Give access to	>									
🐔 TortoiseSVN	>									
Restore previous versions										
Send to	>									
Cut										
Сору										
Create shortcut										
Delete										
Rename										
Properties										E



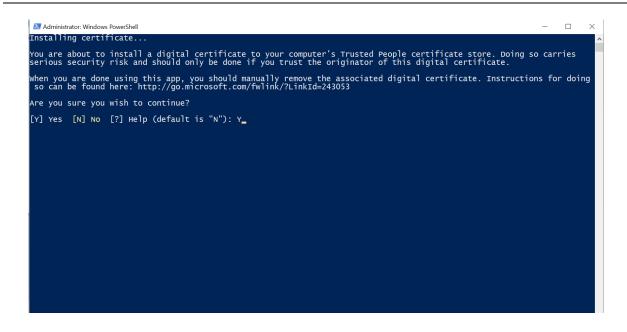


2. Press "Enter" to provide administrator access to the allow installation of the certificates related to the application.

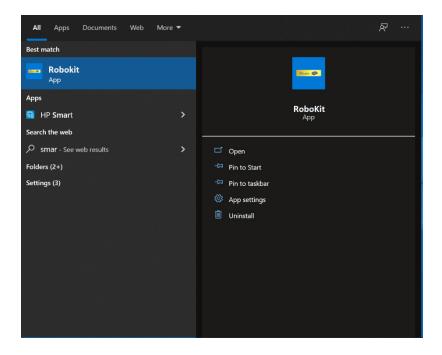








3. Press the Windows key, type "**RoboKit**" and then right-click on it to launch the application.

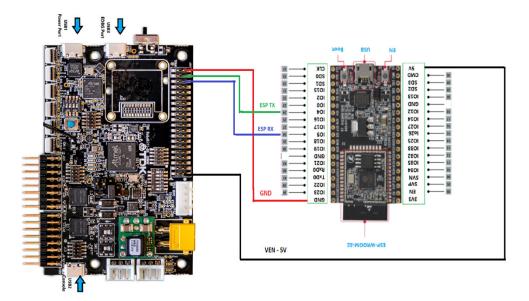




## 3 CONNECTING ESP32 WITH ROBOKIT

RoboKit in a standalone mode offers the capability to communicate with the Host device via USB mode. To achieve wireless data transfer over the BLE interface, an extension board based on ESP 32 is used. Data transfer between RoboKit and ESP happens over the UART at the rate of the 1 Mbps.

Details of the physical connection between the boards is as detailed Figure 8:







**Note:** The ESP32 might need <u>CP210x USB to UART Bridge Virtual COM Port (VCP) drivers</u> which need to installed depending on the user's OS platform. The drivers are available as part of firmware download package in TDK website.





## 4 UPDATING ESP32 FIRMWARE

The Bluetooth connection to RoboKit1 is enabled by ESP32 and the firmware running on it must be kept updated. The ESP32 BLE firmware is provided with the release package. Please follow the steps below to update the firmware:

- 1. Unzip the esp-ble-firmware.zip file
- 2. Connect to ESP32 from your Windows Machine with USB. Identify the Serial Port (Ex. COM1)
- 3. Open Windows PowerShell and navigate to the folder esp-ble-firmware
- 4. Execute the below command

```
./flash-binary.sh <serial-com-port> esp-ble-firmware-vx.y.z.bin
```

where,serial-com-portSerial Port connected to ESP32esp-ble-firmware-vx.y.z.binLatest firmware, x, y and z are version numbers

5. On successful firmware upgrade, the RTS pin will be reset as shown in Figure 9.

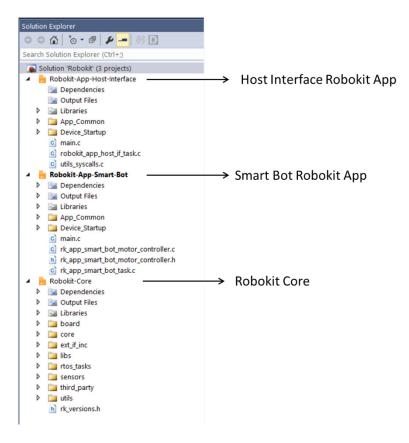
```
sptool.py v3.1-dev
Serial port COM16
Chip is ESP32-DOWD (revision 1)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse, Coding Scheme None
Crystal is 40MHz
MAC: 98:cd:ac:62:d3:28
Uploading stub...
Running stub...
Changing baud rate to 460800
Changed.
Configuring flash size ...
Auto-detected Flash size: 4MB
Flash will be erased from 0x00001000 to 0x00007fff...
Flash will be erased from 0x00008000 to 0x00008fff...
Flash will be erased from 0x00010000 to 0x000befff...
Flash params set to 0x0220
Compressed 25088 bytes to 15383...
Wrote 25088 bytes (15383 compressed) at 0x00001000 in 0.8 seconds (effective 267.3 kbit/s)...
Hash of data verified.
Compressed 3072 bytes to 103...
Wrote 3072 bytes (103 compressed) at 0x00008000 in 0.1 seconds (effective 406.8 kbit/s)...
Hash of data verified.
Compressed 714976 bytes to 427266...
Wrote 714976 bytes (427266 compressed) at 0x00010000 in 10.5 seconds (effective 543.5 kbit/s)...
Hash of data verified.
Leaving...
Hard resetting via RTS pin.
```

6. Restart the ESP32 with a power cycle.



## 5 LOADING ROBOKIT ATMEL BINARY

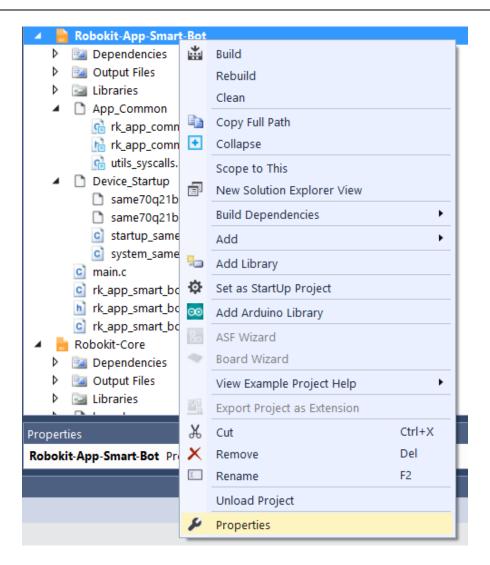
The main solution file, "Robokit.atsIn", for firmware is located at the root folder of the software package and can be opened with Microchip Studio. It includes Robokit-Core and two application project files as shown in the Figure 10. To compile the needed application project, set the application project file as the startup project by right clicking on it and selecting "Set as Startup Project" and them compile it.



To load the image, select properties of Robokit-App as shown in Figure 11.

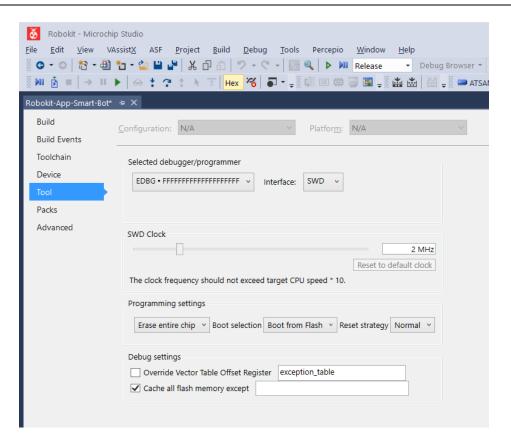






Set EDBG as debugger/Programmer as shown in Figure 12 and click "Start Debugging" or F5.





AN-000346





## 6 CONNECTING TO THE ROBOKIT

TDK offers two products: a stand-alone development board package (TDK\_RoboKit1-DK) and a full robot package (TDK\_RoboKit1).

TDK\_RoboKit1-DK includes:

- Industrial IMU
- Chirp CH101(3x)
- Chirp Connector Cables(3x)
- Windows & Android App for Data collection
- Open-sourced based Board Design files, Firmware and ROS Drivers

Full Robot Package includes:

- Complete "Development Board Package" +
- 3D printed Robot shell with sockets for Time of Flight sensors
- Chassis with Metal plates, Standoffs, Wheels, and Motors
- ESP32 BLE module for BLE connectivity.

#### 6.1 SWITCHING BETWEEN USB AND BLE MODE

To connect the app in USB mode, select the DIP switch SW16 with both switches 1&2 towards ON position as shown in Figure 13.



To connect in BLE mode switches 1&2 should be in OFF position, i.e. both downwards. Caution: Disconnect the USB power prior to modifying the DIP switch settings. The detailed procedure to connect USB or BLE is detailed in sections 6.2 and 6.3.





#### 6.2 USB CONNECTION

1. Click on "Settings."

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Applications	Connection type	BLE $\vee$				
	Unique ID					Connect
O Audio handling	Name					
	Status					Auto connect
Device	Manufacturer name					
M Sensor data	ModelNumber					
<ul> <li>Debug</li> </ul>	SerialNumber					Select Comm Type
	HWVersion					
	FWVersion					
	SWVersion					
	Battery					
	ExpansionBoard					
Settings						
BLE, robokit, Disconnected						





2. Click "Select Comm Type" to choose the communication type.

					- o ×
=	Connection type		- 羽石口智姓 46 《	Hot Reload <	
Applications	Unique ID	BLE 🗸			
	Name				Connect
O Audio handling	Status	Disconnected			
Device	Manufacturer name	Disconnected			Auto connect
	ModelNumber				
₩ Sensor data	SerialNumber				Select Comm Type
<ul> <li>Debug</li> </ul>	HWVersion				Select Comminype
	FWVersion				٨
	SWVersion				Λ
	Battery				ll I
	ExpansionBoard				U
Settings					
BLE, robokit, Disconnected					

3. Click on "**Search**" to look for the available device. Upon finding matching VID and PID, device will be listed in the window.

	· · · · · · · · · · · · · · · · · · ·	- ø ×
=	Connection type BLE V	
Applications	Unique ID	
O Audio handling	Name robokit AC-63-71-76	Connect
	Status Disconnected	
Device	Manufacturer name	Auto connect
₩ Sensor data	ModelNumber	
	SerialNumber	Select Comm Type
Debug	HWVersion	
	FWVersion Master	
	SWIME	
	Battery O BLE	
	ExpansionBoard Stop	
	COM32 robokit	
	CONS2 TOURIE	
	OK Cancel	
	UK Carker	
Settings		
BLE, robokit, Disconnected		

4. Select the device and click **OK**.





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5. Once the connection is established, device parameters are populated on the UI as shown in Figure 18.

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	Connection type	USB 🗸	
Applications	Unique ID	<none></none>	Disconnect
🖒 Audio handling	Name	USB, COM32	Disconnect
	Status	Connected	
Device	Manufacturer name	ROBO KIT	Auto connect
∀ Sensor data	ModelNumber	00	
Debug	SerialNumber	1.0.1-test1	Select Comm Type
- Debug	HWVersion	DDpresence_algo	
	FWVersion	0	
	SWVersion	DDch101fw	
	Battery	0%	
	ExpansionBoard	<none></none>	
🔅 Settings			
USB, COM32, 1.0.1-test1, Connected			

#### 6.3 BLE CONNECTION

#### 6.3.1 Bluetooth Discovery Routine:

1. Select option: "**BLE**," and click on "**Search**" to discover the RoboKit1 module. Once a device is detected, "Robokit" will be listed for the users to choose.





			] 🕼 🐺 😝 🚱 Hot Reload <	- 8 ×
	Connection type	BLE V		
Applications	Unique ID	ULL *		
Audio handling	Name	robokit 68-48-29-90		Connect
	Status	Disconnected		
levice	Manufacturer name			Auto connect
M Sensor data	ModelNumber			
Debug	SerialNumber			Select Comm Type
Debug	HWVersion			
	FWVersion	Master		
	SWVersion	● BLE		
	Battery		Search Stop	
	ExpansionBoard	O use	Junch Stop	
		Robokit	68-48-29-90	
		nobokit		
		ок	Cancel	
Settings				



## 7 DEVICE SELECTION

#### Select the device and click OK

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Applications     Unque D     Image D     Connect       Ande handing     Name     model de 45-35-0     Image D       Davie     Model dander     Image D     Image D       Station and Image D     Model dander     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Model dander     Image D     Image D     Image D       Image D     Image D     Image D     Image D     Image D       Image D     Image D     Image D     Image D     Image D <th></th> <th>Connection type</th> <th></th> <th></th>		Connection type		
Audo handing     Name     noblek 864.85.95.95       Status     Disconnection       Manufacturer name     □ Auto nomet       M Setter name     □ Auto nomet       Debug     Setter name       M Steme risk     ■ Setter name       Polog     Setter name       M Steme risk     ■ Setter name       Polog     <	Applications			
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E Debug Selektardar Miller Miller Silekt Comm Type Master Silekt Comm Type Silekt Comm Type Sil		ModelNumber		
HWWerkins HWWerkins Development Streams Expansion/board Expansion/board RoboKit 68-46-29-90		SerialNumber		Select Comm Tvn
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© Setings			OK Cancel	

Once the BLE device is selected, press the **Connect** button to connect the RoboKit1 module to the RoboKit app. After clicking connect, wait a few seconds until the device parameters appear. If the **Auto connect** checkbox is checked, the selected device will connect automatically on the application restart.

#### 7.1 CONNECTING BLE FOR THE FIRST TIME

When connecting BLE for the first time, the device should pair with the Windows system to begin the communication. Click "**Yes**" to proceed.

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=	Co	nnection type	BLE V	
Applications		ique ID		Close connection
Audio handling	N	me		close connection
	Sta	atus	Disconnected	
Device	M	anufacturer name		Auto connect
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Debug	Se	rialNumber		Select Comm Type
	HV	Wersion		
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		ttery	Let SwartBug pair your device with rebuilt	
	Eq	pansionBoard		
			Let SmartBug pair your device with robokit	
			Yes No	
Settings				





Successful device pairing takes roughly around 30s. Once it is done, press the "**Connect**" button to establish connection.

						- a x
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	Unique ID	robokit AC-63-71-76				Connect
O Audio handling	Name Status	Disconnected				
Device	Manufacturer nan					Auto connect
	ModelNumber	ie i				
₩ Sensor data	SerialNumber					Select Comm Type
Debug	HWVersion					Select Commitype
	PWVersion					
	SWVersion					
	Battery					
	ExpansionBoard					
Settings						
BLE, robokit, Disconnected	1					

After clicking Connect, wait a few seconds until the device parameters appear. If the "**Auto connect**" checkbox is checked, the selected device will connect automatically on the application restart. Refer to Figure 18.





## 8 SENSOR DATA CAPTURE AND LOGGING

#### 1. Click on "Sensor data."

This window is the most important section of the app, as it allows users to stream multi-sensor data and record that data into log files.

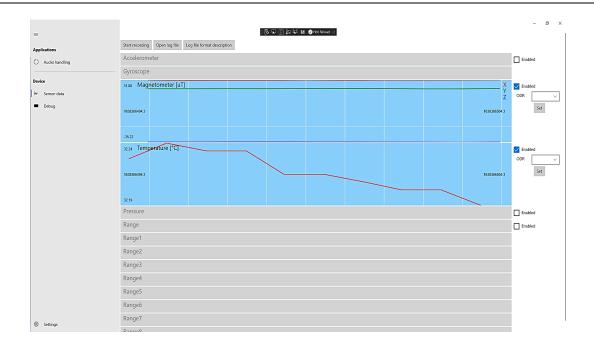
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	Connection type	USB 🗸	
Applications	Unique ID	<none></none>	Disconnect
🖒 Audio handling	Name	USB, COM32	
	Status	Connected	
Device	Manufacturer name	ROBO KIT	Auto connect
₩ Sensor data	ModelNumber	00	
	SerialNumber	1.0.1-test1	Select Comm Type
Debug	HWVersion	DDpresence_algo	
	FWVersion	0	
	SWVersion	DDch101fw	
	Battery	0%	
	ExpansionBoard	<none></none>	
Settings			
USB, COM32, 1.0.1-test1, Connected			
,,,,			

oplications	Start recording Open log file Log file format description								
Audio handling	Accelerometer	Enable							
	Gyroscope								
ivice	Magnetometer	Enable							
Sensor data	Temperature								
<ul> <li>Debug</li> </ul>	Pressure								
	Range	Enable							
	Range1								
	Range2								
	Range3								
	Range4								
	Range5								
	Range6								
	Range7								
	Range8								
Settings									

2. Select the sensor(s) of interest by checking the **Enabled** checkboxes to begin the plotting.



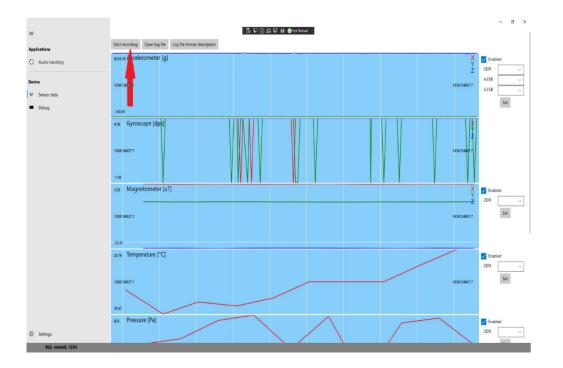








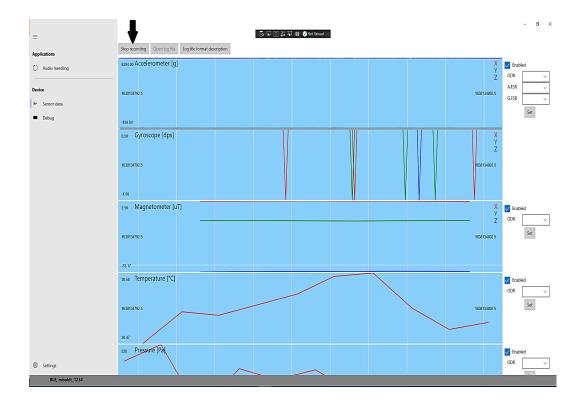
3. Begin data recording by clicking on the "**Start recoding**" button. The app starts recording data for all sensors selected.







4. Stop recording the data by clicking on the "Stop recording" button. Recording for all sensors will stop.



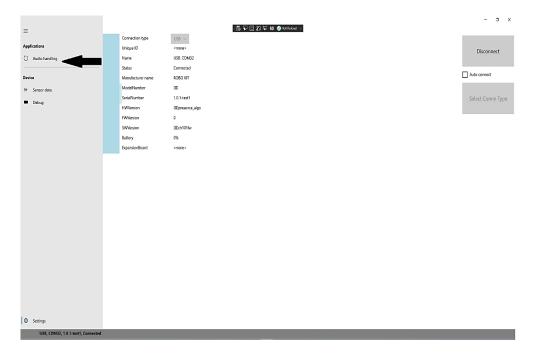




## 9 AUDIO DATA CAPTURE

The app also facilitates the capturing of audio data streamed by the RoboKit1 board. For audio data capture and validation follow the steps below:

1. Click on "Audio Handling"







2. Select "Enabled" and click on "Start Recording". Say "HI TDK" toward the board. The red LED will turn solid and around 1s of audio data will start streaming to the app and get recorded onto the file. The red LED will turn off after the streaming stops.

=	AUDIO 동, 무 🗇 🕼 🕼 🕼 de tricond 🕜	- 6	×	
Applications	🖉 trabled			
O Audio handling	Start recording Open log file			
Device				
₩ Sensor data				
Debug				
Settings				
USB, COM32, 1.0.1-test1, Connected				1

3. While the app facilitates the audio data capture, use the audio specialty tools like Audacity to verify the data validity as detailed below:





a. Launch the Audacity application on your computer, and follow the guideline as shown in Figure 30.

New Open Recent Files	Ctrl+N Ctrl+O	M	• I Q	<i>₹</i> ⁄ ⇔*	↓ L     −54     ↓     R     ↓	-48 -42 -48 -42		oring -18 -1: -24 -18 -1			10 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -			Q
Close	Ctrl+W													
Save Project	>	ophone Array (R			(Mono) Recording					1				
Export	>	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	
Import	>	Audio	Ctrl+Shif	t+l										
Page Setup		Labels												
Print		MIDI Raw Data		_										
Exit	Ctrl+Q	Naw Data	•											





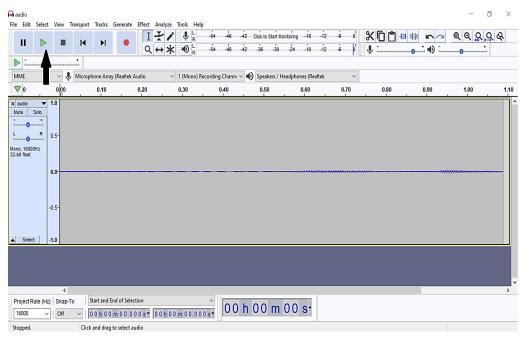
b. Click on "**Raw Data**" to launch a dialog to select audio file. Then choose the configuration as shown below and click "**Import**."

🔒 Audacity														- 0	$\times$
File Edit Select	View Transpor	t Tracks	Generate Effect									• 1 1 1			-
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▼ - 1.0	do	1.0	2.0	3.0	4.0	5.0	)	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0
	< *					Byte order: Channels: Start offset: Amount to Sample rate	Signed 16 Little-end 1 Channel import: 1 s:	ian (Mono) 00 5000 ~ ort	× v v bytes % Hz Cancel						*
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c. After importing the audio, click the **PLAY** button as indicated, and the recorded audio data will play.



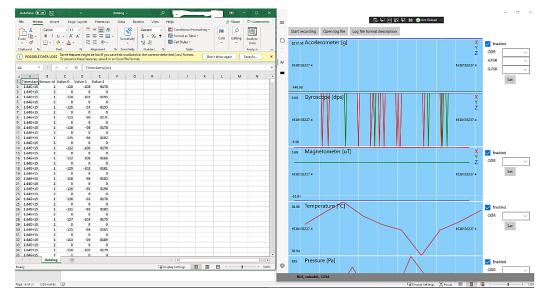


## 10 LOGGING

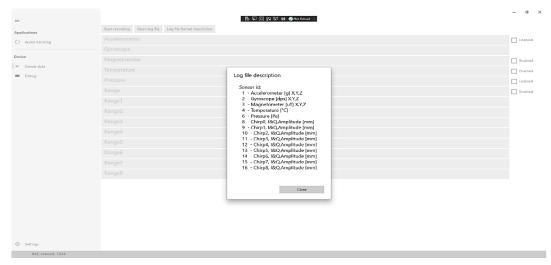
1. Click "Open log file" to view recorded data and a Microsoft Excel file opens automatically.

Logs will be in the path

C:\Users\XXXXX\AppData\Local\Packages\InvenSenseInc.SmartBug\_cg71h24es2qyy\LocalState



2. Click on the "Log file format description" to understand the sensor IDs and units in log file.

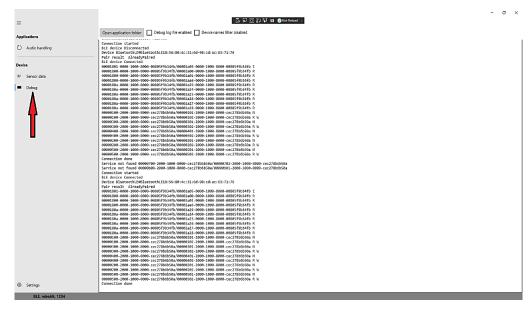




## **11 USE DEBUG MENU TO SEE MESSAGES LOG**

All activities in the app are recorded in the debug window. This can help with troubleshooting and debugging the application.

Detailed app debug messages can be enabled by the **"Debug file enabled"** button. In this case, all communication messages will be logged into a file, located in the application data folder. The folder can be launched in File Explorer by clicking the **"Open application folder"** button.







## **12 REVISION HISTORY**

REVISION DATE	REVISION	DESCRIPTION
01/16/2022	1.0	Initial release
02/28/2022	1.1	Added section 5



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