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Analog Devices, Inc.

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ADI VITAL SIGNS MONITORING (VSM) WATCH IV USERS GUIDE

Revision List**Table 1: Revision List**

Revision	Date	Description
0.1	27-July-2020	Initial Draft
0.2	4-Aug-2020	Updated sections for DCB commands and removed irrelevant sections
0.3	10-Oct-2020	Updated the latest release features
0.4	23-Nov-2020	Updated the UDP structures for all the streams
0.5	09-Dec-2020	Updated the Multiview features
0.6	10-Feb-2021	Updated the Low Touch features
0.7	12-Mar-2021	Updated the HR support in the usecases

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1 Introduction

The ADI VSM Study Watch is a product designed to showcase the capabilities of ADI's sensors for measuring vital signs.

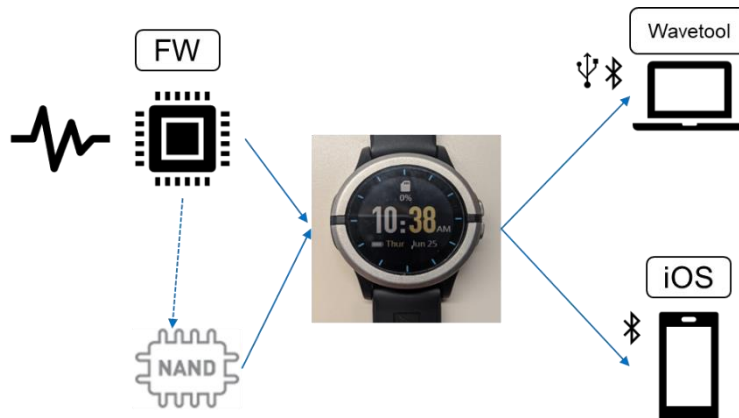


Figure 1: ADI VSM Study Watch Framework

1.1 Purpose

The purpose of this document is to explain the steps on how to connect and run the ADI VSM Study Watch to analyze VSM application data using ADI's Wavetool Software.

2 Hardware

Please refer to the to the ADI VSM Study Watch datasheet for detailed hardware information.

The watch comes with a charging cradle – with micro USB charging capability



Figure 2: ADI VSM Study Watch with charging cradle

2.1 Watch Connections

2.1.1 Boot mode Buttons



Figure 3: Navigate and Action Buttons

2.1.2 USB Connections

There are two micro USB ports in the cradle.

- Data micro USB port for charging and connecting to the Wavetool
- External electrode micro USB port for connecting to the external electrode

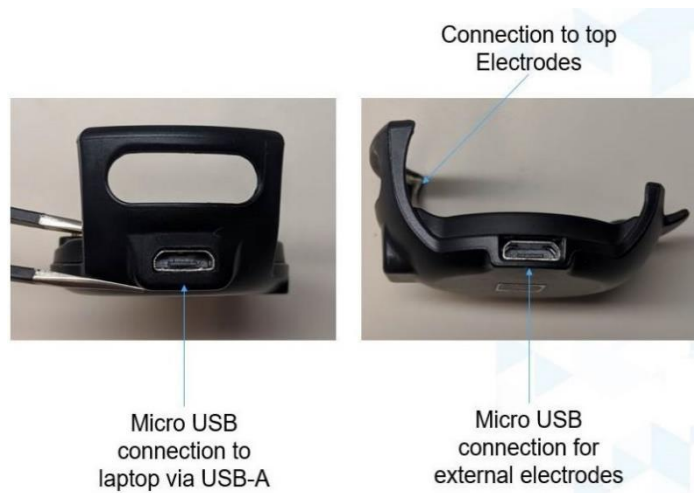


Figure 4: USB Connection

2.1.3 Nordic BLE Dongle Setup

To connect the watch in the Wavetool software using BLE, the user may need to program the [nRF52840 Dongle](https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Connect-for-desktop). Please follow the steps below to program the BLE dongle to be discovered as a COM port in Wavetool.

1. Install nRfConnect from the given link - <https://www.nordicsemi.com/Software-and-tools/Development-Tools/nRF-Connect-for-desktop> - Download the latest version for Windows.
2. Install the Programmer and open the Programmer



Figure 5: nRF Connect App

3. Plug in the BLE dongle and put the device in Boot mode by pressing the black button as shown in the figure. A LED will start blinking red.



Figure 6: Nordic BLE Dongle

4. Select the dongle via the nRF Connect Programmer



Figure 7: Connecting the BLE Dongle in Boot mode

5. Add HEX file from the path – <WAVETOOL_INSTALL_FOLDER>\etc\BLEdongle\ADIBLEdongle_S140.hex
6. Write the firmware to the dongle. The messages as shown in the figure below will indicate the completion of the firmware update.

Log	
10:41:05.383	DFU procedure completed successfully!
10:41:05.383	1 dfu package(s) left.
10:41:05.383	Waiting for device
10:41:05.429	DFU procedure starts. This may take a few seconds.
10:41:11.801	DFU for Application completed successfully!
10:41:11.801	0 dfu package(s) left.
10:41:11.801	Waiting for device

Figure 8: Firmware Update Completion

7. Unplug and re-plug the dongle.

3 Quick Start Guide

The below sections will detail the steps involved in connecting the watch to WaveTool and successfully running VSM applications.

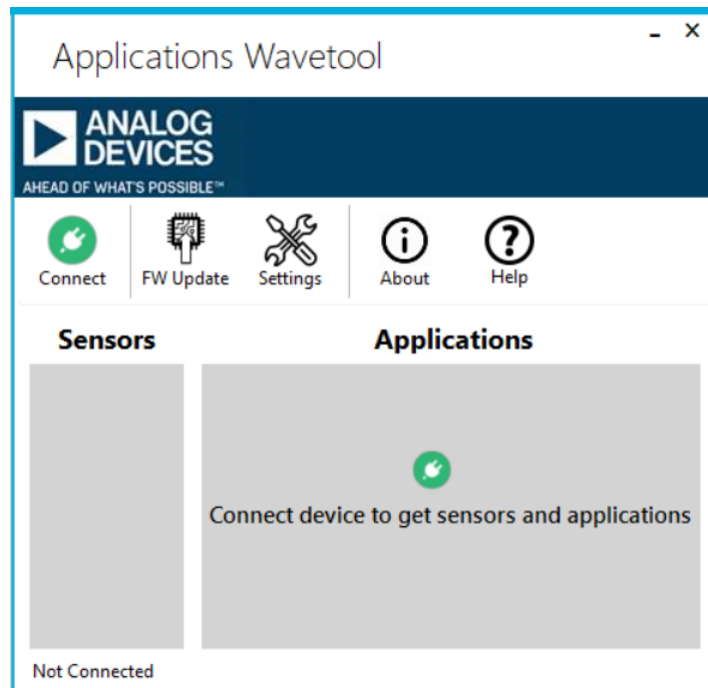


Figure 9: Wavetool Software Main Window

3.1 Updating Firmware

If this is your first time using the watch, then please update the firmware. Otherwise you can skip this section and proceed to connecting with the Watch.

Please follow the steps below to update the firmware for the watch.

- Please remove all the USB Serial Devices and the BLE Dongle since Wavetool automatically selects the first device COM port for updating the firmware
- Attach the watch to the charging cradle
- Connect the watch to the PC through USB
- Open Wavetool Software
- Click on the FW Update
- Select 'Perseus'
- Hold down both the 'Navigation' and 'Action' buttons for 5 seconds and confirm the bootloader icon in display
- Click on 'Continue' to finish the Firmware update

Note: In case after hitting continue, wavetool selects incorrect com port to upload the firmware, remove the dongle connected to your computer and try again.

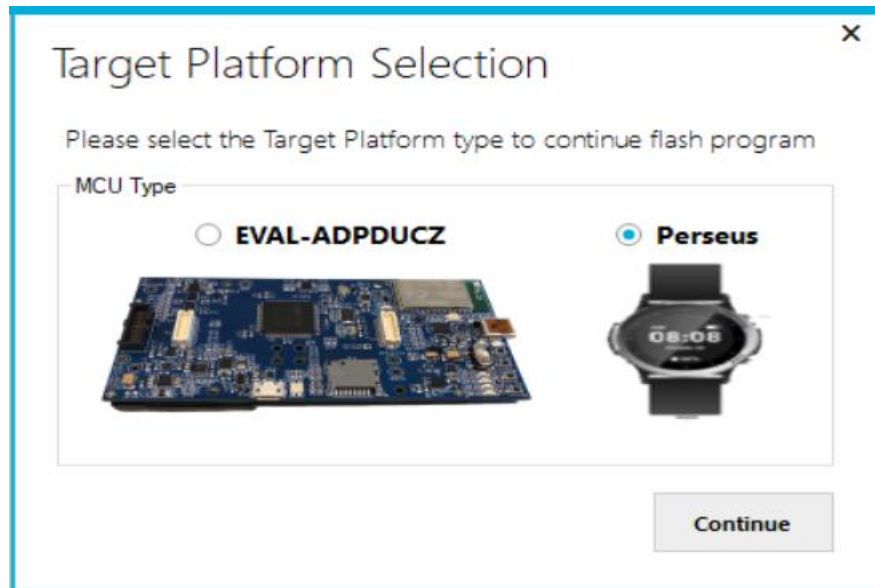


Figure 10 : Firmware Update Window in Wavetool

3.2 Connecting to the Watch

3.2.1 Connecting using USB (Cradle)

- Attach the watch to the charging cradle
- Connect the watch to the PC through via USB(Recommended not to use USB hub)
- Open Wavetool Software
- Click on Connect → Cable
- Select the appropriate COM port of the watch and connect. You can refer the device manager to find the watch COM port

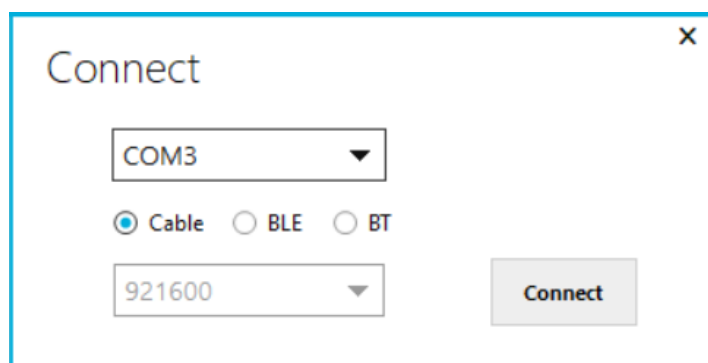


Figure 11: USB Cable connection to the Watch

- On successful connection, the following message will be displayed, after that WT will display the supported applications

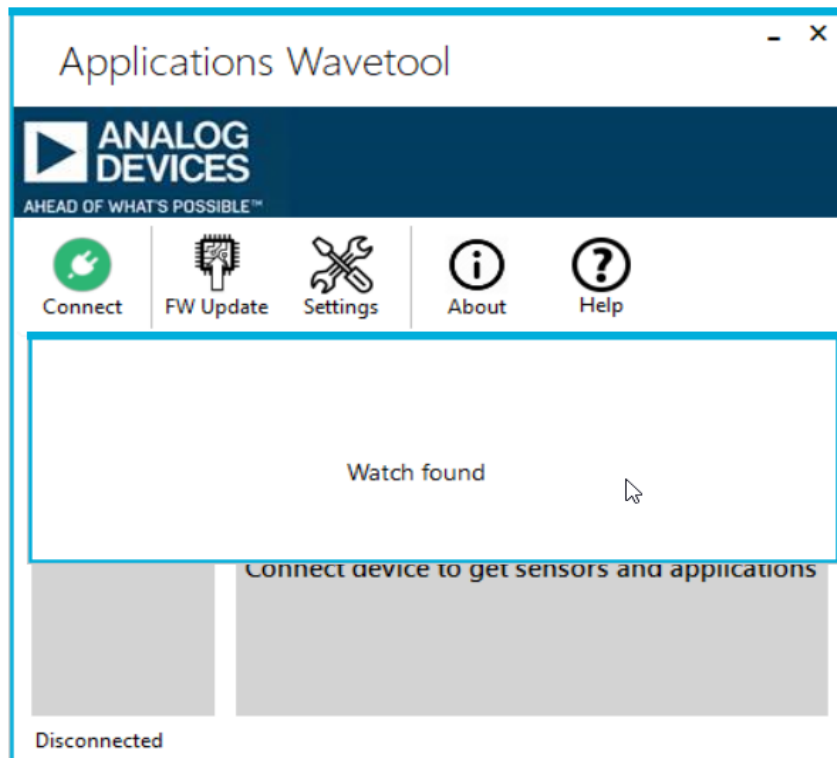


Figure 12 : Device Connected

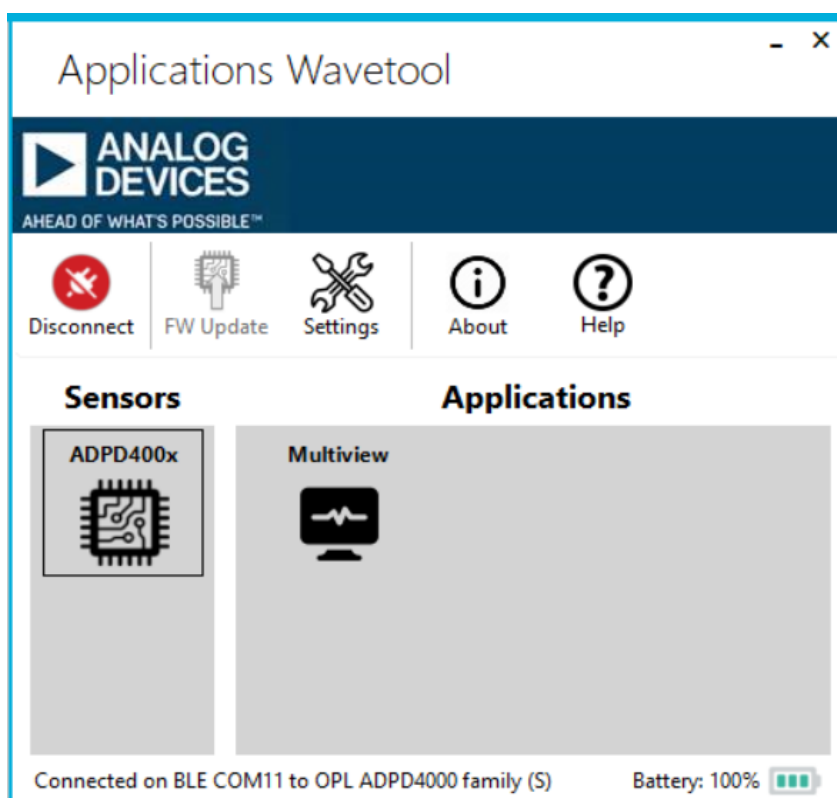


Figure 13 : Application Selection

3.2.2 Connecting using BLE

- Connect the BLE dongle to the PC
- Update the BLE firmware as explained in Section 2.1.3 (If needed)
- Open Wavetool Software
- Click *Connect* → *BLE*
- Select the appropriate COM port and click on 'Scan'

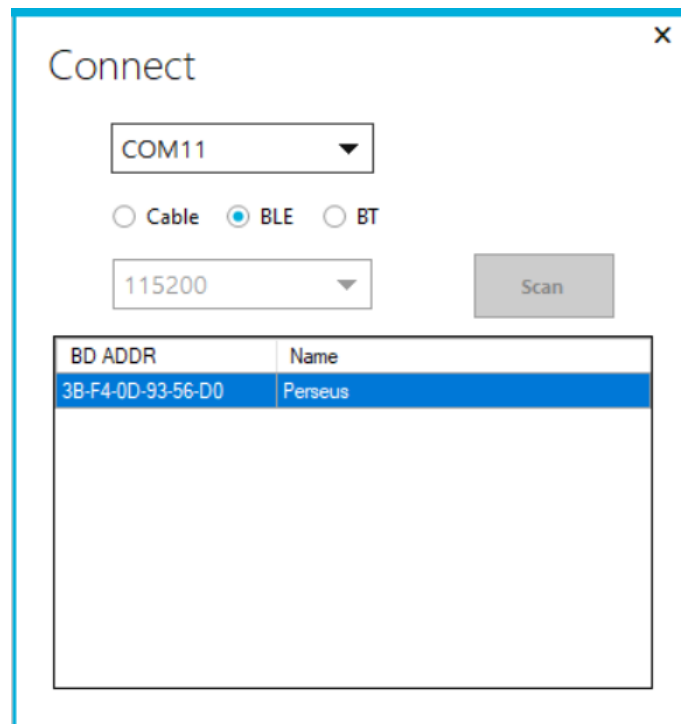

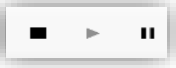









Figure 14 : BLE Connection

- Select the BLE device from the list shown and double click to connect. MAC ID of the watch could be read from Settings- > MAC id sub page. On plugging in dongle to WT & scanning, MAC ID of the watch could be checked against the scan list shown in WT.
- On successful connection "Watch Found" message will be displayed, after that WT displays the supported applications.

3.3 Basic Wavetool View Controls

Basic View Controls

	Stop mode
	Play mode
	Pause mode
	Open config settings
	UDP Enable
	Nandflash logging
	Logs the data in the local machine
	DCB Access
	Low Touch Settings

The controls of the view are as explained below:

1. **Play:** Start streaming data from the sensors
2. **Stop:** Stop streaming data from the sensors and clear the plots
3. **Pause:** Pause the streaming and show the current data on the plots
4. **Settings:** Opens the configuration settings to set the configuration for the use case.
5. **UDP:** Send the graph data through the UDP
6. **Nandflash logging:** Logs the selected data streams into the NAND Flash
7. **Log:** Save the data from the sensors into a JSON and CSV file in local PC
8. **DCB (Device Configuration Block) Access:** The nRF52840 MCU has a NOR flash which enables user to save and load the config in the local flash. This utility will enable users to write, read, erase the config in the NOR flash
9. **Low Touch (LT) Logging:** This allows user to configure the LT configuration via nandflash and DCB. LT config and tuning view is explained separately in the upcoming sections

10. **Filter:** This allows user to set an appropriate filter for the raw PPG data stream.
- Type:** The filter type is to choose the type of the filter like BandPass (BP), Moving Average or Low Pass and is limited to a set of filters defined in the '`<WAVETOOL_INSTALL_FOLDER>\etc\FilterConfig\FilterType.json`' file.
- Tap Count:** The number of taps for the filter type chosen
11. **AGC (Automatic Gain Control):** This option is to enable or disable the AGC for the LED which is selected in the slot selection
12. **SQI (Signal Quality Index):** The SQI feature is supported for PPG signal frequencies ranging from 25-100Hz. The SQI score is a floating-point value between 0(poor signal quality) and 1(excellent quality).

3.4 Multiview Application

This is the application which will enable users to analyse a combination of VSM applications in a single view

3.4.1 Running Use-cases for the Multiview

- Open Wavetool
- Update the firmware for the watch (If needed)
- Connect using BLE or USB
- Open Multiview under the Applications box.
- Select the necessary use case to be analysed
- Configure their settings such as Filter type, Slot selection, AGC Enable, etc.
- Press 'Play' to analyse the data streams

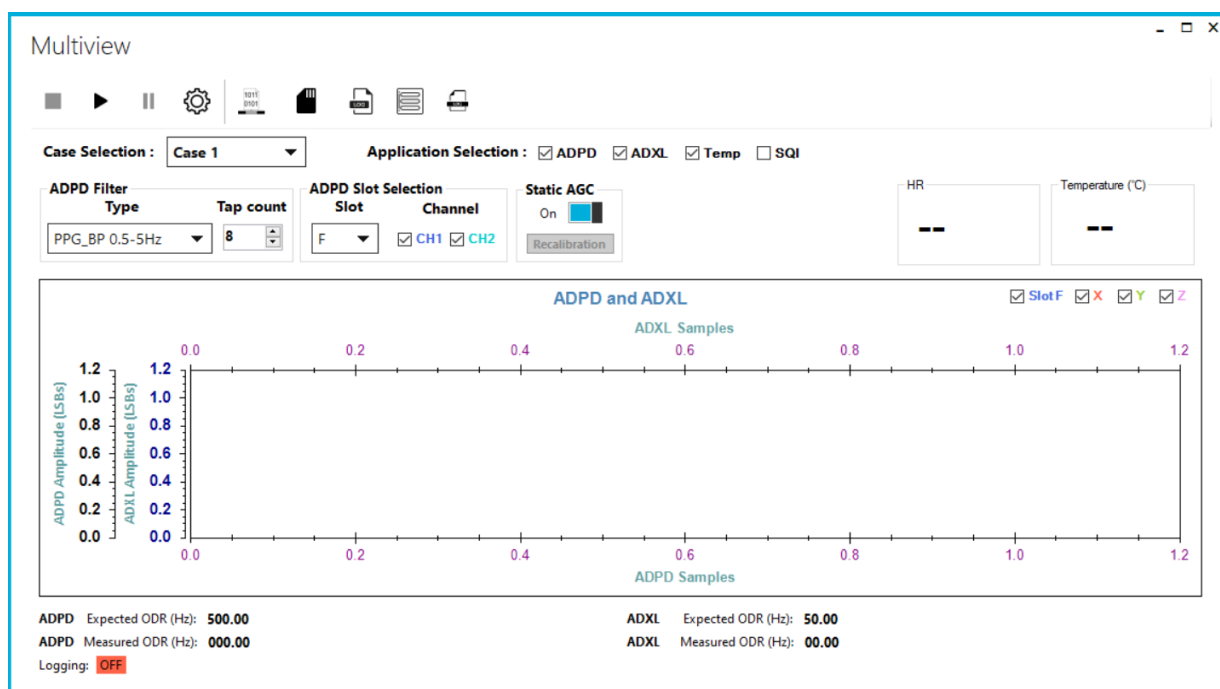


Figure 15 : Multiview

Note: Deselecting the applications from application selection window before starting stream will remove the graph for that sensor and make more room for the sensor of interest

3.4.2 Multiview Usecases

3.4.2.1 Usecase1 - ADPD High Performance

Usecase1 used to analyse the ADPD at high data rate. The default settings are ADPD – 500Hz, ADXL – 50Hz and Temperature – 1Hz



Figure 16: Multiview ADPD + ADXL

3.4.2.2 Usecase2 - ADPD + EDA

Usecase2 used to analyse the EDA along with the ADPD application. The default settings are ADPD – 100Hz, ADXL – 50Hz, EDA – 30Hz ODR, 100Hz Excitation Frequency and Temperature – 1Hz



Figure 17 : Multiview ADPD + EDA

3.4.2.3 Usecase3 - ADPD + ECG

Usecase3 used to analyse the ECG along with the ADPD application. The default settings are ADPD – 100Hz, ADXL – 50Hz, ECG – 250Hz and Temperature – 1Hz



Figure 18 : Multiview ADPD + ECG

3.4.2.4 Usecase4 - PPG + ECG (High Performance)

Usecase4 used to analyse the PPG and ECG. The default settings are PPG – 50Hz, ECG – 1000Hz and Temperature – 1Hz

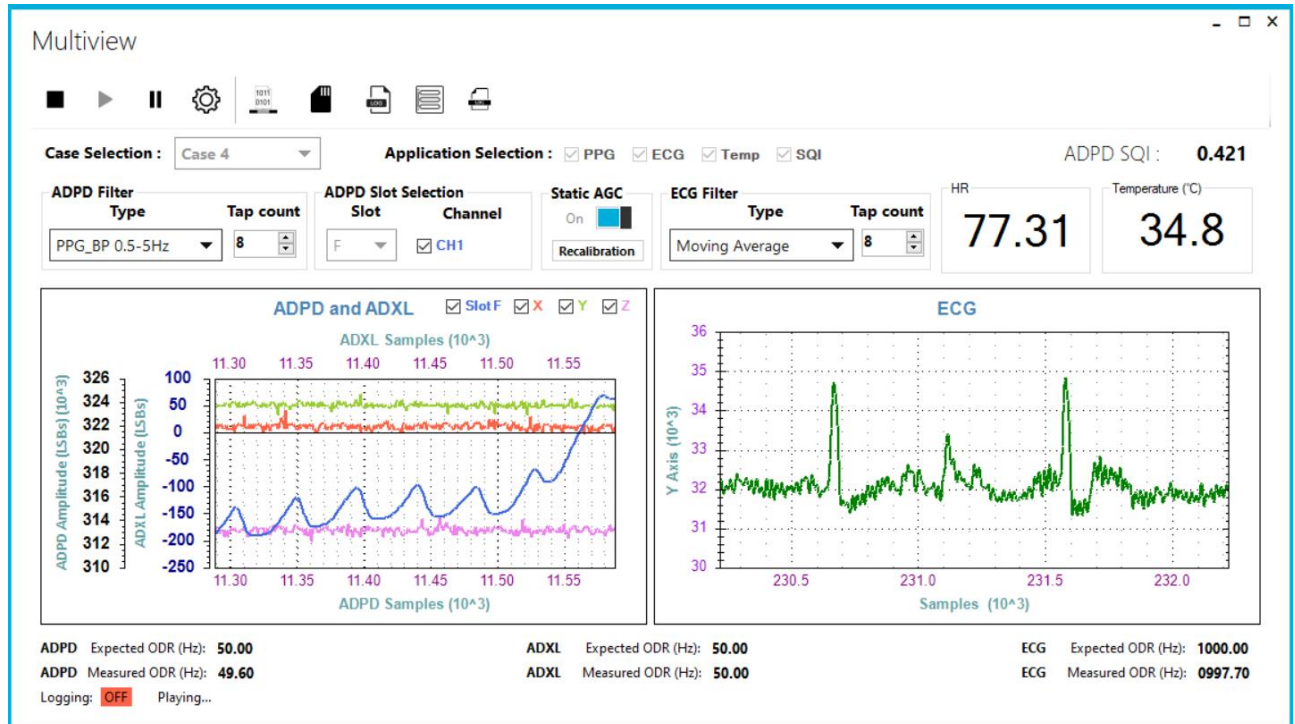


Figure 19 : Multiview PPG + ECG

3.4.2.5 Usecase5 - ADPD Multislot

Usecase5 used to analyse ADPD with multi slot settings and their AGC. The default settings are ADPD – 100Hz and ADXL – 50Hz

The slots selection and AGC settings can be changed in the slot selection window

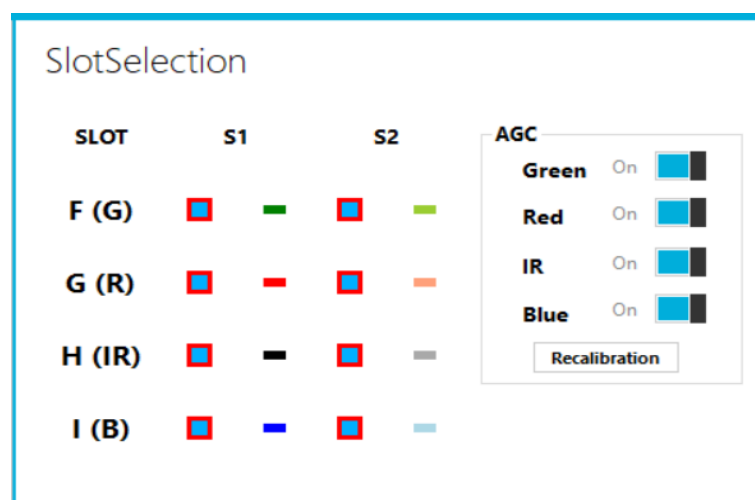


Figure 20 : Slot selection



Figure 21 : Multiview ADPD multislot

3.4.3 Configuring Use-cases for the Multiview

The Multiview will allow users to run a combination of VSM apps as defined in the “<WAVETOOL_INSTALL_FOLDER>\etc\MultiviewProperty.json”

It's advisable to use the use case with the default views supported and it depends on the applications to be analysed.

To modify the existing use case

1. Modify the JSON entry with
 - a. “Freq”: Sampling rate for each of these applications

These are the use cases supported in the Multiview and its default frequency values. These values will be loaded when we are switching between the use cases.


```

{
  "MultiviewInfo": [
    {
      "CaseInfo": [{"Case": 1}],
      "Views_Supported": ["ADPD", "ADXL", "TEMPERATURE", "SQI"],
      "Freq": [{"ADPD": 500}, {"ADXL": 50}, {"TEMPERATURE": 1}],
    },
    {
      "CaseInfo": [{"Case": 2}],
      "Views_Supported": ["ADPD", "ADXL", "EDA", "TEMPERATURE", "SQI"],
      "Freq": [{"ADPD": 100}, {"ADXL": 50}, {"EDA": 30}, {"TEMPERATURE": 1}],
    },
    {
      "CaseInfo": [{"Case": 3}],
      "Views_Supported": ["ADPD", "ADXL", "ECG", "TEMPERATURE", "SQI"],
      "Freq": [{"ADPD": 100}, {"ADXL": 50}, {"ECG": 250}, {"TEMPERATURE": 1}],
    },
    {
      "CaseInfo": [{"Case": 4}],
      "Views_Supported": ["ADPD", "ADXL", "ECG", "TEMPERATURE", "SQI"],
      "Freq": [{"ECG": 1000}, {"TEMPERATURE": 1}],
    },
    {
      "CaseInfo": [{"Case": 5}],
      "Views_Supported": ["ADPD", "ADXL", "SQI"],
      "Freq": [{"ADPD": 100}, {"ADXL": 50}],
    },
  ],
}

```

Figure 22: Multiview Use-case Definition File

3.4.4 Multiview Controls

3.4.4.1 DCB Access

This utility will enable users to write, read, erase the config in the NOR flash

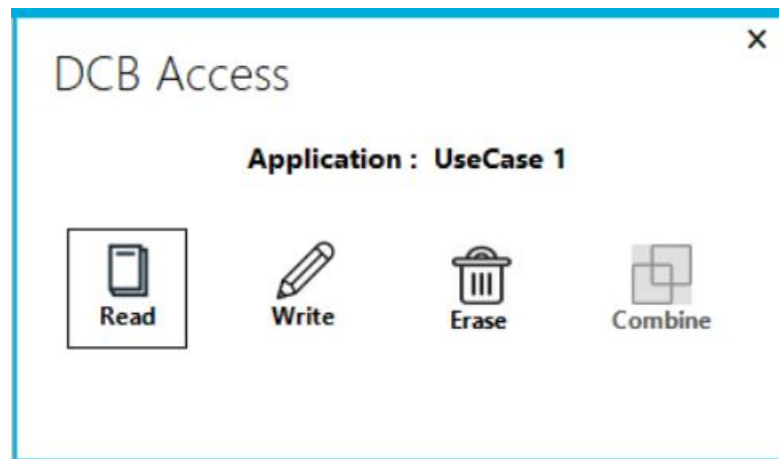


Figure 23 : DCB Access

Read: Read DCB config from NOR flash

Write: Write DCB to config into NOR flash (existing DCFG)

Erase: Erase DCB contents in the NOR flash

Once a DCB is written, it will be persistent between watch resets, until it is explicitly deleted. The application would work with DCB configuration, if available (default firmware configuration is overridden).

If the particular use case DCB is written to the NOR flash, then the application works with the configuration irrespective of the use case. Write the corresponding DCB configuration for the corresponding use case.

Alert messages for DCB present based on the applications supported by the particular use case are provided as below and it is represented in the application selection also.



Figure 24 : DCB in Multiview

3.4.4.2 Low Touch Configuration

Low touch (LT) allows for a few unique features when using the watch. It allows the watch to be preconfigured to automatically log specific data streams if the watch is on the user's wrist (based on a capacitance measurement) – when it is off the wrist, the device will stop logging and then go to a lower power state. This mode is used to start/stop logging without the use of button/tool

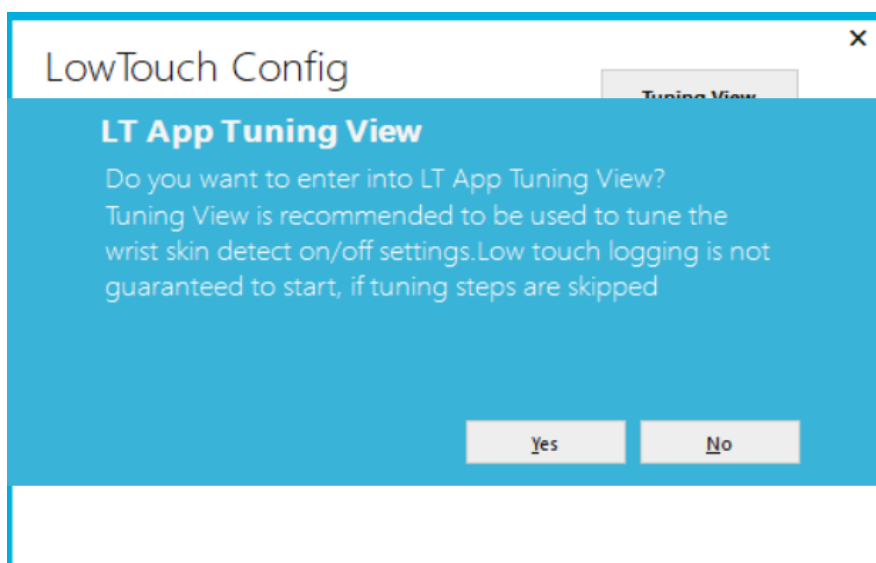


Figure 25 : Low Touch Tuning Selection

When the Low Touch Configuration is clicked the above alert message is displayed to enter into the Low Touch Tuning window in order to tune the wrist detect on/off for the low touch application.

The wrist detection is based on capacitance change that is detected by the touch sensor, at the bottom part of watch. There would a change in capacitance, when watch is placed on wrist from where it was kept initially – another surface like air or a table. This difference in capacitance is not a fixed value and varies between person to person and even from one watch to another. To improve the accuracy for wrist detection and thus to improve the LT application, the latter works with a default firmware lcfg, which is reconfigurable. LowTouch tuning window of WT serves this purpose.

By clicking “Yes” it will direct to the LowTouch tuning window as below

LowTouch Tuning

Low Touch application works from either a firmware lcfg or a user-defined wrist detect DCB. The appropriate selection can be made from drop-down selection

Tuning Selection Default/Modified FW Lcfg

Tuning process requires air and skin capacitance to be entered by user via BLE. The steps are

- Press Read button next to the Current capacitance box to see the current LT Capacitance value
- With watch face on air, without touching bottom touch sensors, note air capacitance by pressing Read button next to Current Capacitance box. Enter this value in the Air Capacitance box
- By placing the watch bottom touch sensor on the wrist and straps tightened, note skin capacitance by pressing Read button next to Current Capacitance box. Enter this value in the Skin Capacitance box

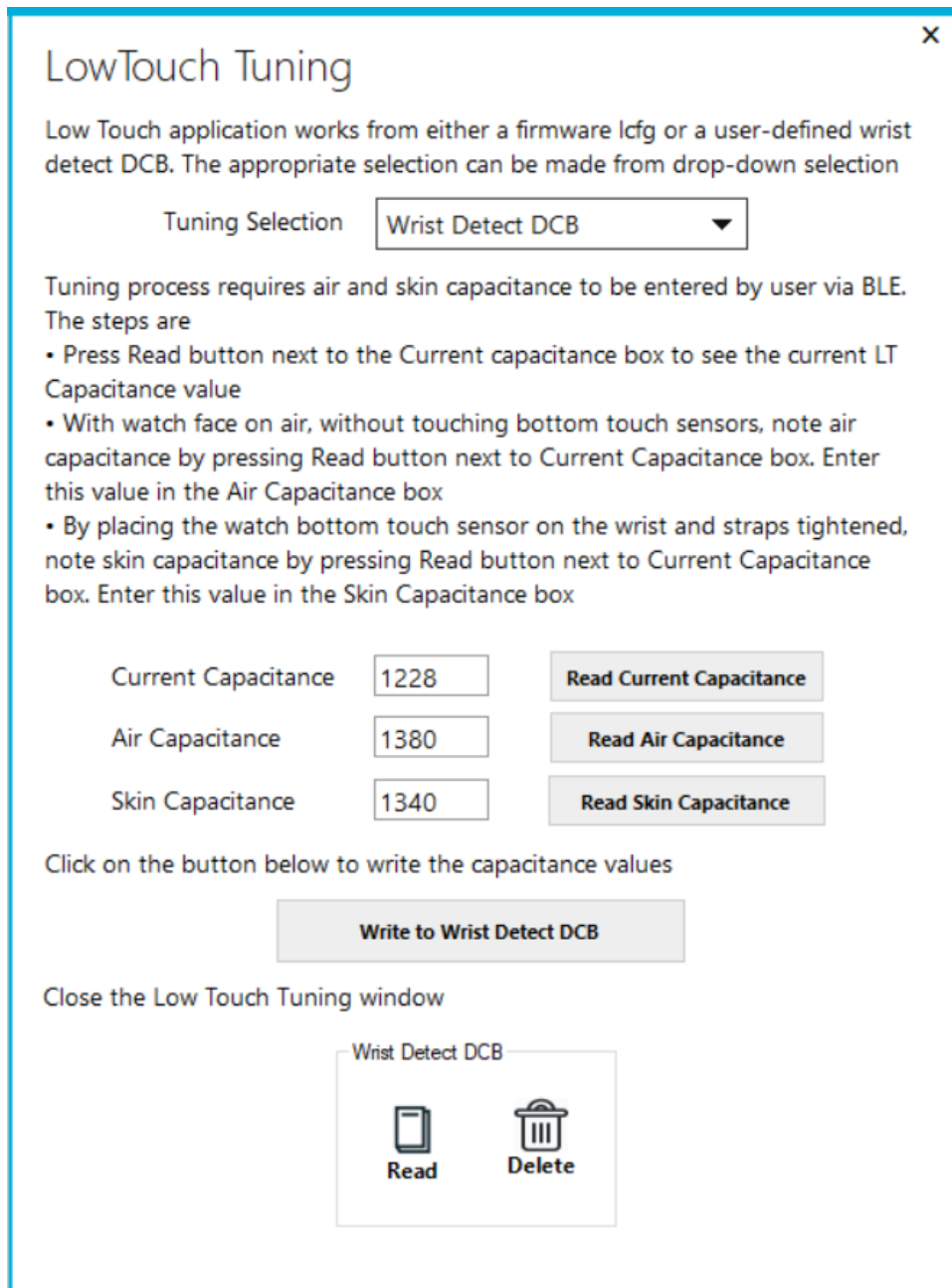
Current Capacitance	<input type="text" value="1228"/>	<input type="button" value="Read Current Capacitance"/>
Air Capacitance	<input type="text" value="1380"/>	<input type="button" value="Read Air Capacitance"/>
Skin Capacitance	<input type="text" value="1340"/>	<input type="button" value="Read Skin Capacitance"/>

Click on the button below to write the capacitance values

Close the Low Touch Tuning window

Figure 26 : Low Touch Tuning FW Lcfg

Follow the steps to write the capacitance values to the Default/Modified FW Lcfg.



The image shows a software window titled "LowTouch Tuning" with a close button (X) in the top right corner. The window contains the following elements:

- Header:** "LowTouch Tuning" with a close button (X).
- Text:** "Low Touch application works from either a firmware lcfg or a user-defined wrist detect DCB. The appropriate selection can be made from drop-down selection".
- Tuning Selection:** A dropdown menu currently showing "Wrist Detect DCB".
- Text:** "Tuning process requires air and skin capacitance to be entered by user via BLE. The steps are".
- List of steps:**
 - Press Read button next to the Current capacitance box to see the current LT Capacitance value
 - With watch face on air, without touching bottom touch sensors, note air capacitance by pressing Read button next to Current Capacitance box. Enter this value in the Air Capacitance box
 - By placing the watch bottom touch sensor on the wrist and straps tightened, note skin capacitance by pressing Read button next to Current Capacitance box. Enter this value in the Skin Capacitance box
- Input fields and buttons:**

Field	Value	Button
Current Capacitance	1228	Read Current Capacitance
Air Capacitance	1380	Read Air Capacitance
Skin Capacitance	1340	Read Skin Capacitance
- Text:** "Click on the button below to write the capacitance values".
- Button:** "Write to Wrist Detect DCB".
- Text:** "Close the Low Touch Tuning window".
- Footer:** A box titled "Wrist Detect DCB" containing two icons: a document icon labeled "Read" and a trash can icon labeled "Delete".

Figure 27 : Low Touch Tuning Wrist detect DCB

For wrist detect DCB, we have options to read and delete the wrist detect capacitance values which is already written in the DCB.

If the wrist detect DCB is already present when the LT view is opened, then the warning will be shown as "WRIST_DETECT_DCB is present".

After the tuning is done, LowTouch Config window is displayed as below

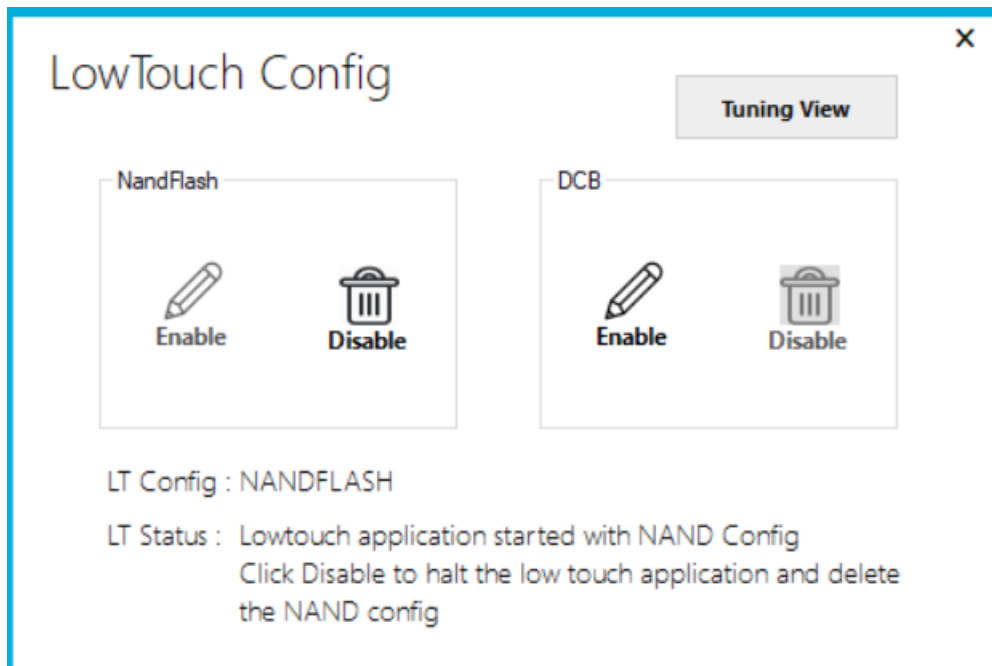


Figure 28 : Low Touch Config

LowTouch Config window is to be used to write the LT configuration file – either the DCB file or the NAND config file onto the watch by clicking the Enable button. The corresponding message will be displayed as below

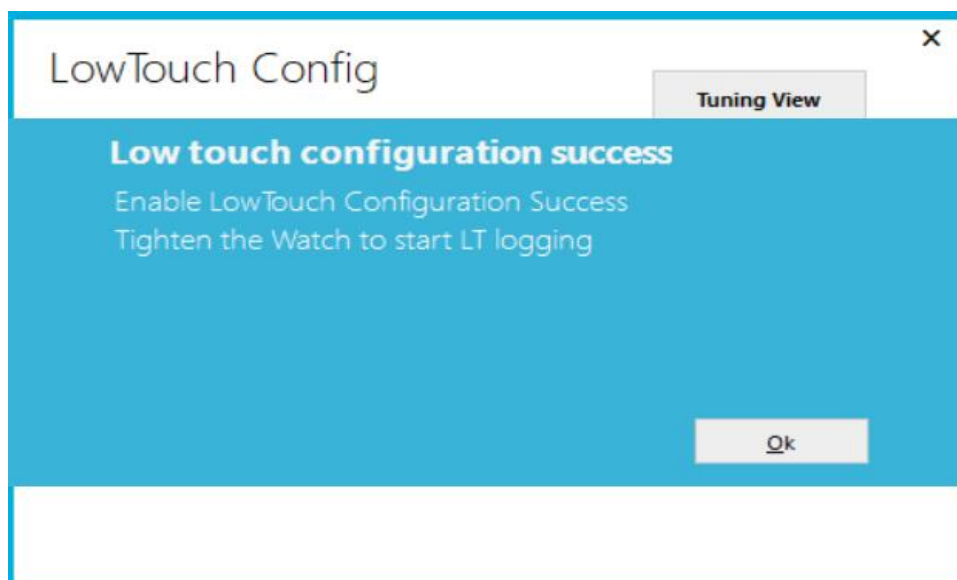


Figure 29 : Low Touch Config Success

Deletion of the config file is also done using the Disable button, if LT logging is not started.

After writing the config file to the watch, the LT application gets launched and it starts/stops logging depending on the wrist ON/OFF. The corresponding messages will be displayed in the AWT.

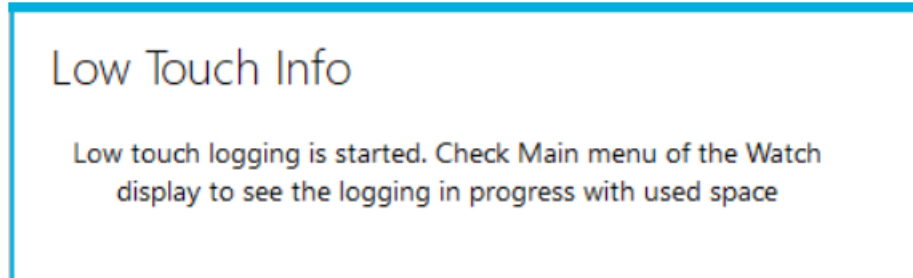


Figure 30 : Low touch started

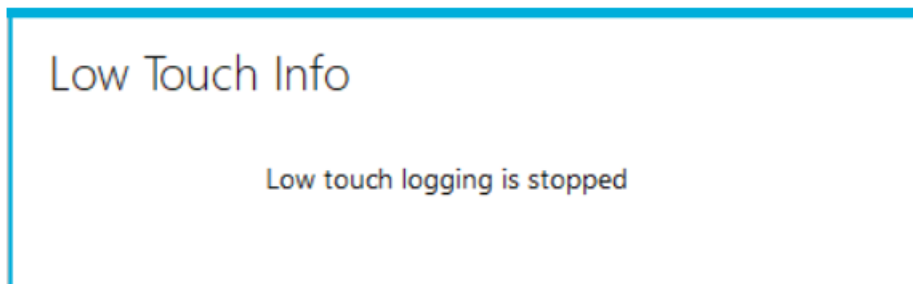
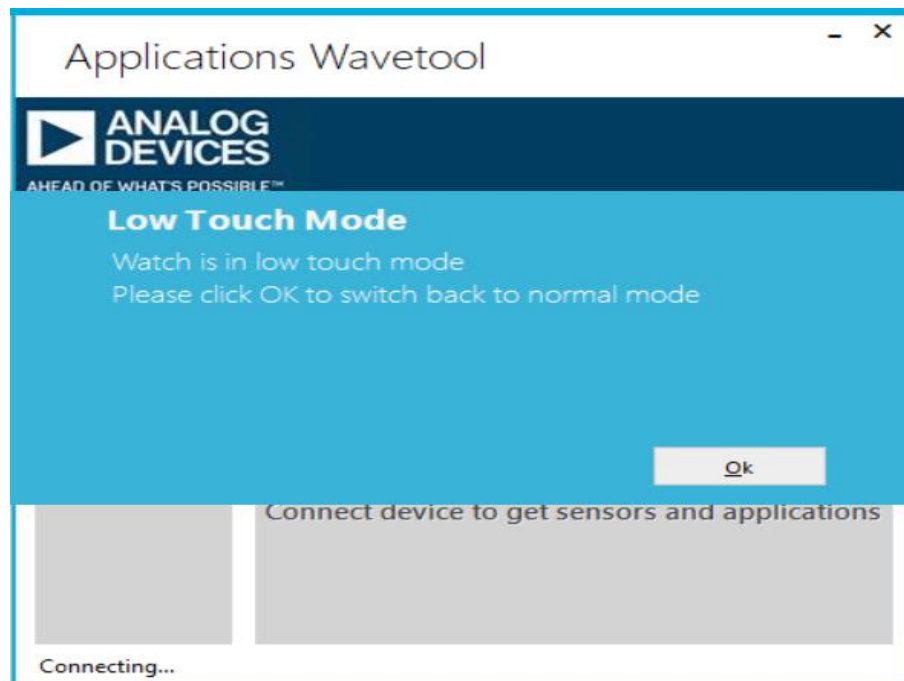


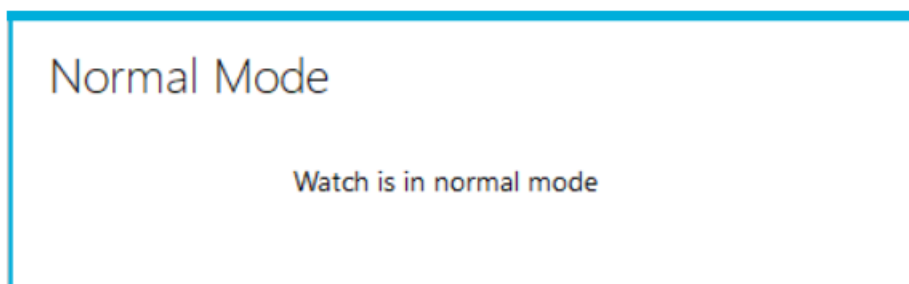
Figure 31 : Low touch stopped

Once LT config file is written into the Watch from LT Logging View of the Multiview, the user can disconnect from the WT, to do further tests. On connecting a Watch to AWT, it detects if LT application is active. User should accept to switch Watch to normal mode to continue using the AWT. The LT config files (both DCB and nandflash) get deleted when the Watch switches to the normal mode.

**Figure 32 : Low touch mode**

Switching to normal mode from LT mode fails, if LT logging is in progress. Watch needs to be taken off the wrist, to stop LT logging. If even after removing the Watch, LT logging continues, (this can happen if LT tuning is not proper), then user can disable LT app from the Watch display. From LOW_TOUCH_LOGGING page in Watch display and within that the LT APP sub-page, press action button to disable the LT Application. After this connect Watch to AWT and accept to switch to Normal mode. If wrist detect DCB is present, then user will be asked whether to delete this DCB or not.

After switching back to the normal mode, the below message will appear and the connection will be established

**Figure 33 : Watch normal mode**

3.4.5 Configuring Settings for the Applications in Multiview

The configuration of settings will be based on the use-case selected. A separate config for ADPD, ADXL, ECG, etc will be provided as shown in the figure below. Users can

- *Load* a saved config file
- *Save* the current config in a new file
- *Apply* the modified config to the system

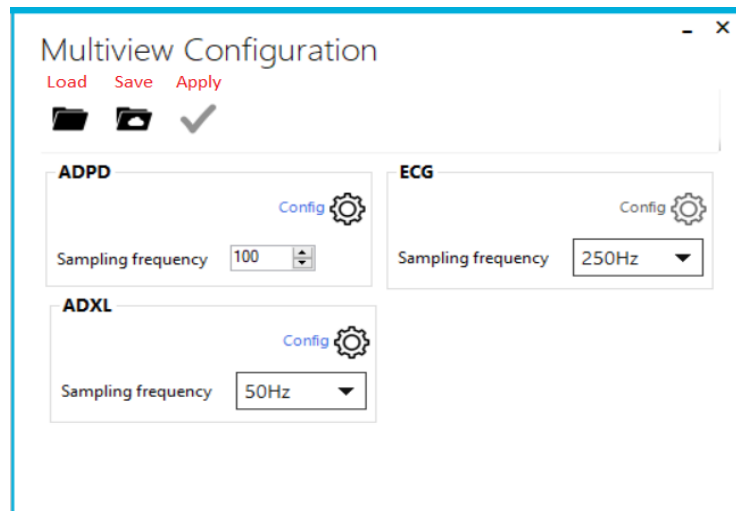


Figure 34: Multi-view Configuration

3.5 AWT Extension Modules

Wavetool allows user to transfer graph data (applications selected in the use case) via UDP to an external application for post processing.

Graph Data Sources	
ADPD4100	0xA1
ADXL	0xB0
PPG	0xC0
Reserved	0xC1
ECG	0xC2
EDA	0xC3
TEMP	0xC4

ADPD:

0	1-2	3-4	5-8	9-20	21	22-23	24 -...	
Source	Length	Seq No	Timestamp	Slot Info	Int Status Flag	Reserved	Data (double – 8bytes each)	Interrupt Status

Source	0xA1 – ADPD4x00 data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
Timestamp	Current time in milliseconds
Slot Info	<i>Slot Info</i> [0] - D1: 1- enabled, 0 -disabled [1] - D2: 1- enabled, 0 -disabled [2] - S1: 1- enabled, 0 -disabled [3] - S2: 1- enabled, 0 -disabled [4] - L1: 1- enabled, 0 -disabled [5] - L2: 1- enabled, 0 -disabled
Interrupt Status Flag	<i>Interrupt Status Flag</i> [4] 0 - Interrupt Data Not available 1 - Interrupt Data Available
Data	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat
Interrupt Status data	All Interrupt data is in 8-byte doubles format. Where the double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic.

ADXL:

0	1-2	3-4	5	6-8	9-10	11 -...
Source	Length	Seq No	No of Sample	Reserved (Header Info)	Reserved (Info)	Data (double – 8bytes each)

Source	0xB0 – ADXL data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
No of Sample	Number of samples in the packet
Data (Timestamp& Data)	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat Data format : [TS, X, Y, Z]

PPG:

0	1-2	3-4	5	6-8	9-10	11 -...
Source	Length	Seq No	No of Sample	Reserved (Header Info)	Reserved (Info)	Data (double – 8bytes each)

Source	0xC0 – PPG data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
No of Sample	Number of samples in the packet
Data (Timestamp& Data)	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat Data format : [TS, ADPD, X, Y, Z, HR]

ECG:

0	1-2	3-4	5	6-8	9	10	11	12-13	11 -...
Source	Length	Seq No	No of Sample	Reserved (Header Info)	Sensor Type	Algo/ Electrode Type	Lead Status	Reserved	Data (double – 8bytes each)

Source	0xC2 – ECG data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
No of Sample	Number of samples in the packet
Sensor Type	Sensor Info [3:0] 0 - AD7689 1 - AD5940 2 - AD4000 3 - None Reserved [7:4]
Algo/Electrode Type	Algo Info [3:0] 0 - None 1 - Sport 2 - Monitor Electrode Info [7:4] 0 - None 1 - Case/Watch 2 - Lateral/External

Lead Status	Lead Info [1:0] 0 - OFF 1 - ON
Data (Timestamp& Data)	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat Data format : [TS, ECG, HR]

TEMPERATURE:

0	1-2	3-4	5	6-8	9-10	11 -...
Source	Length	Seq No	No of Sample	Reserved (Header Info)	Reserved (Info)	Data (double – 8bytes each)

Source	0xC4 – Temperature data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
No of Sample	Number of samples in the packet
Data (Timestamp& Data)	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat Data format : [TS, Temp1, Temp2]

EDA:

0	1-2	3-4	5	6-8	9-10	11 -...
Source	Length	Seq No	No of Sample	Reserved (Header Info)	Reserved (Info)	Data (double – 8bytes each)

Source	0xC3 – EDA data packets
Length	Total UDP Packet Length
Seq No	Sequence number for packet count from 0 to 0xFFFF, rolls over
No of Sample	Number of samples in the packet
Impedance /Admittance	Sensor Info [3:0] 0 - Impedance 1 - Admittance
Data (Timestamp& Data)	All data is in 8-byte doubles format. Dependent on Slot Info. The double type complies with the IEC 60559:1989 (IEEE 754) standard for binary floating-point arithmetic. See: DoubleDataFormat Data format: [TS, Module, Phase]

The Graph data is packetized and sent via the port settings as specified in the Settings window.

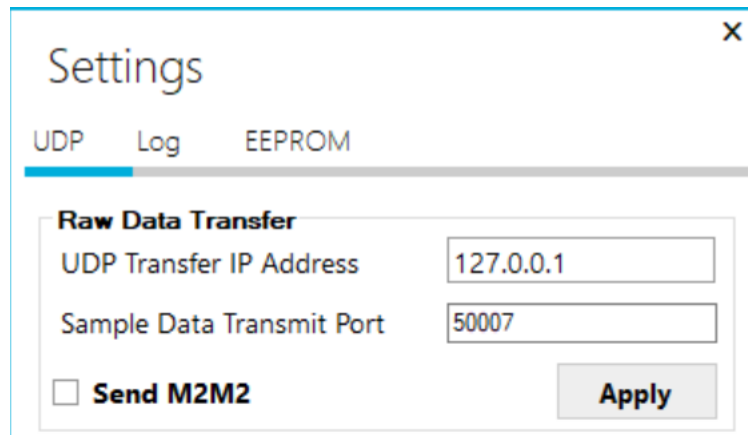


Figure 35: UDP Settings for Data Transfer

In the Multiview the UDP transfer is enabled as shown in figure below

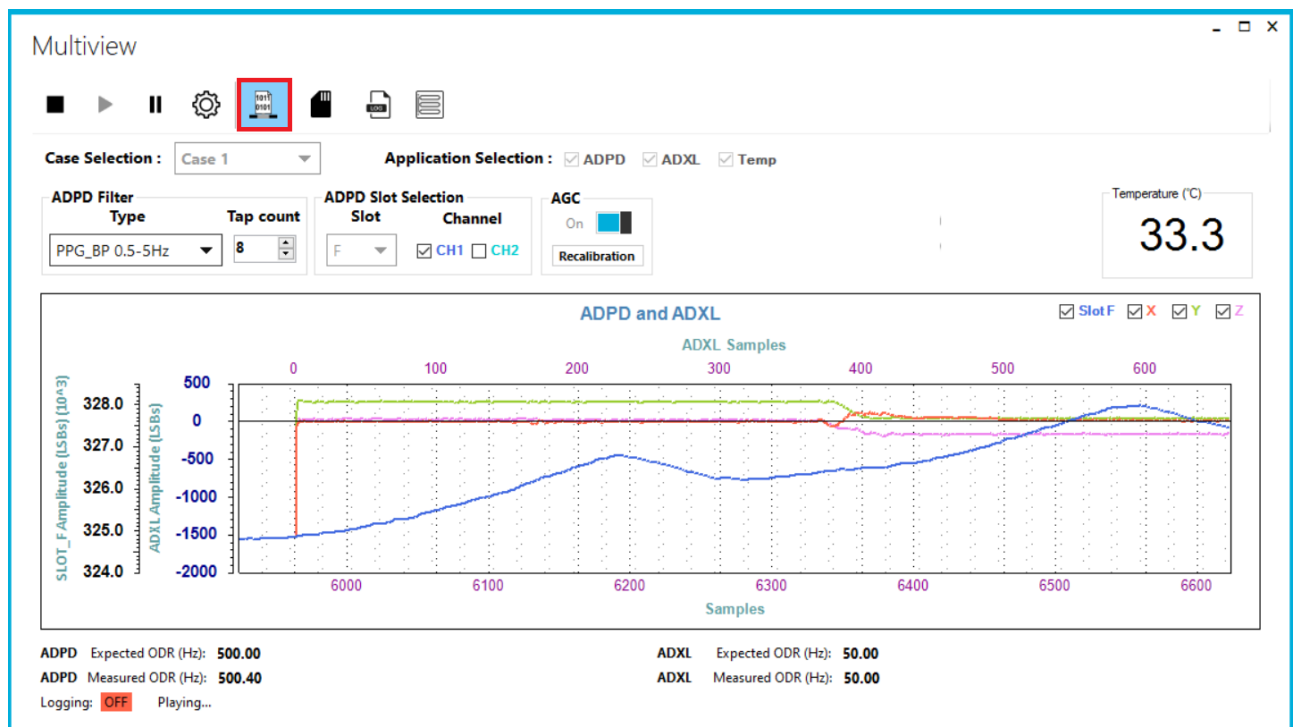


Figure 36 : Multiview UDP enable

The AWT External Modules which contains the parser to extract the data from the Wavetool to different applications such as:

- Python
- LabView

- Matlab

These parser modules and examples to get the data out from Wavetool can be found in

<https://github.com/analogdevicesinc/ApplicationsWaveTool>.

3.6 Logging Data in Local Files

Raw data can be logged in local files which are stored in JSON or CSV file format.

JSON TO CSV Conversion Completed. [Click to open log](#)

Figure 37 : Open Log

After the log stops, the “Click to open log” hyperlink is shown in the bottom of the view. Clicking the hyperlink opens the location where the logs are stored.

The log folder can be opened from the open logs folder in settings window logging tab

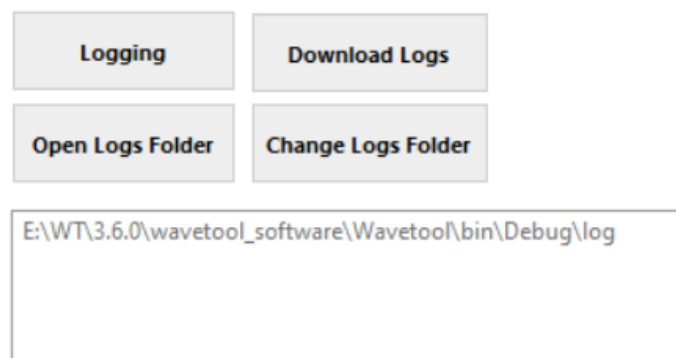


Figure 38 : Logging Settings

The log folder contains the m2m2, JSON and CSV files

Name	Date modified	Type
200825_0941PM_082553A6	25-08-2020 21:41	File folder

Figure 39 : Log Folder

Name	Date modified	Type	Size
CSV	25-08-2020 21:41	File folder	
JSON	25-08-2020 21:41	File folder	
082553A6.m2m2	25-08-2020 21:41	M2M2 File	45 KB

Figure 40 : Log Files

The m2m2 file is the log file that was retrieved from the device

The CSV and JSON folders contain equivalent files generated from the m2m2 file

The CSV folder contains the logging data and summary





Name	Date modified	Type	Size
 082553A6_ADPDAppStream_Combined_CSV	25-08-2020 21:41	Microsoft Excel Co...	80 KB
 082553A6_ADXLAppStream	25-08-2020 21:41	Microsoft Excel Co...	10 KB
 082553A6_Summary	25-08-2020 21:41	Microsoft Excel Co...	1 KB
 082553A6_TemperatureStream	25-08-2020 21:41	Microsoft Excel Co...	1 KB

Figure 41 : CSV Folder

ADPDAppStream_Combined_CSV log file is shown below

	A	B	C	D	E	F	G
1	Local:	#####	#####	tz_sec	19800		
2	Linux Epoch (ms):	1.6E+12					
3		SLOT F (500.00Hz)					
4		Ch1			Ch2		
5		Epoch Del	D1	S1	D2	S2	
6		159.438	0	313899	0	382016	
7		159.438	0	313864	0	382003	
8		159.438	0	313887	0	382054	
9		159.438	0	313826	0	382035	
10		159.438	0	313827	0	382027	
11		159.438	0	313854	0	382061	
12		171.844	0	313844	0	382069	
13		171.844	0	313794	0	382030	
14		171.844	0	313791	0	382022	
15		171.844	0	313796	0	382059	
16		171.844	0	313761	0	382008	
17		171.844	0	313786	0	382011	
18		184.188	0	313755	0	382005	
19		184.188	0	313788	0	382020	
20		184.188	0	313802	0	382068	
21		184.188	0	313835	0	382072	
22		184.188	0	313812	0	382047	
23		184.188	0	313804	0	382050	

Figure 42 : CSV Data

JSON folder contains the JSON file which is converted from the m2m2 file


Name	Date modified	Type	Size
 082553A6.m2m2	25-08-2020 21:41	JSON File	452 KB

Figure 43 : JSON Folder

```

1 ("JSONVersion": "1.5.3")
2 ("PMSysInfo": {"RawPacket": {"src": "50432", "dst": "50947", "len": "21", "chksum": "0"}, "DateTimeInfo": {"year": 2020, "month": 8, "day": 25, "hour": 21, "minute": 41, "second": 41, "tz_sec": 19800}})
3 ("PMSysInfo": {"RawPacket": {"src": "50432", "dst": "50947", "len": "17", "chksum": "0"}, "McuTypeInfo": {"mcu": 2}, "QoffsetStatus": 0, "MathOpStatus": 0, "StatsOffsetStatus": 0, "LifStatus": 0})
4 ("CTRSettings": {"RawPacket": {"src": "53504", "dst": "53760", "len": "79", "chksum": "0"}, "CTREnabled": 0})
5 ("CTRSettingsADPDCL": {"RawPacket": {"src": "54528", "dst": "54784", "len": "383", "chksum": "0"}, "CTREnabled": 0, "Sampling_Frequency": 500.0, "Decimation_A": 1, "Decimation_B": 1, "Decimation_
6 ("ECGSettings": {"RawPacket": {"src": "54016", "dst": "54272", "len": "80", "chksum": "0"}, "ECGEnabled": 0, "ECGFilterType": 0, "ECGUnitType": 0})
7 ("ADXLAppStream": {"RawPacket": {"src": "49666", "dst": "50947", "len": "55", "chksum": "0"}, "Info": "ADI_MAIL_SENSOR_RAW_DATA_ADXL", "accel": [{"segno": "160"}, {"ts": 651687101076.59375, "x":
8 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1343"}, {"Channel_num": 1, "Timestamp": 651687101159.4375, "Sa
9 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1343"}, {"Channel_num": 2, "Timestamp": 651687101159.4375, "Sa
10 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1344"}, {"Channel_num": 1, "Timestamp": 651687101171.84375, "Sa
11 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1344"}, {"Channel_num": 2, "Timestamp": 651687101171.84375, "Sa
12 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1345"}, {"Channel_num": 1, "Timestamp": 651687101184.1875, "Sa
13 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1345"}, {"Channel_num": 2, "Timestamp": 651687101184.1875, "Sa
14 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1346"}, {"Channel_num": 1, "Timestamp": 651687101196.5625, "Sa
15 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1346"}, {"Channel_num": 2, "Timestamp": 651687101196.5625, "Sa
16 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1347"}, {"Channel_num": 1, "Timestamp": 651687101208.90625, "Sa
17 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1347"}, {"Channel_num": 2, "Timestamp": 651687101208.90625, "Sa
18 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1348"}, {"Channel_num": 1, "Timestamp": 651687101221.28125, "Sa
19 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1348"}, {"Channel_num": 2, "Timestamp": 651687101221.28125, "Sa
20 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1349"}, {"Channel_num": 1, "Timestamp": 651687101233.625, "Samp
21 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1349"}, {"Channel_num": 2, "Timestamp": 651687101233.625, "Samp
22 ("ADXLAppStream": {"RawPacket": {"src": "49666", "dst": "50947", "len": "55", "chksum": "0"}, "Info": "ADI_MAIL_SENSOR_RAW_DATA_ADXL", "accel": [{"segno": "161"}, {"ts": 651687101179.5625, "x": 3
23 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1350"}, {"Channel_num": 1, "Timestamp": 651687101246.0, "Sample
24 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1350"}, {"Channel_num": 2, "Timestamp": 651687101246.0, "Sample
25 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1351"}, {"Channel_num": 1, "Timestamp": 651687101258.34375, "Sa
26 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1351"}, {"Channel_num": 2, "Timestamp": 651687101258.34375, "Sa
27 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1352"}, {"Channel_num": 1, "Timestamp": 651687101270.71875, "Sa
28 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1352"}, {"Channel_num": 2, "Timestamp": 651687101270.71875, "Sa
29 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1353"}, {"Channel_num": 1, "Timestamp": 651687101283.0625, "Sa
30 ("ADPDCLAppStream": {"RawPacket": {"src": "49686", "dst": "50947", "len": "44", "chksum": "0"}, "Source": "6", "ADPDCL": [{"segno": "1353"}, {"Channel_num": 2, "Timestamp": 651687101283.0625, "Sa

```

Figure 44 : JSON Data

3.7 NAND Flash Logging

When a user wants to log data on the watch they can enable the NAND flash logging.

While the NAND flash is logging, the user can go to any other application and stream and stop the data, this doesn't affect the NAND flash logging. NAND flash logging stops when the user disables the logging.

3.7.1 Logging in NAND Flash

Logging of data into the Nand flash can be enabled from the “Settings” menu in Wavetool.

- Connect to the watch using BLE
- Open Wavetool Main window
- Open Settings → Log → Logging

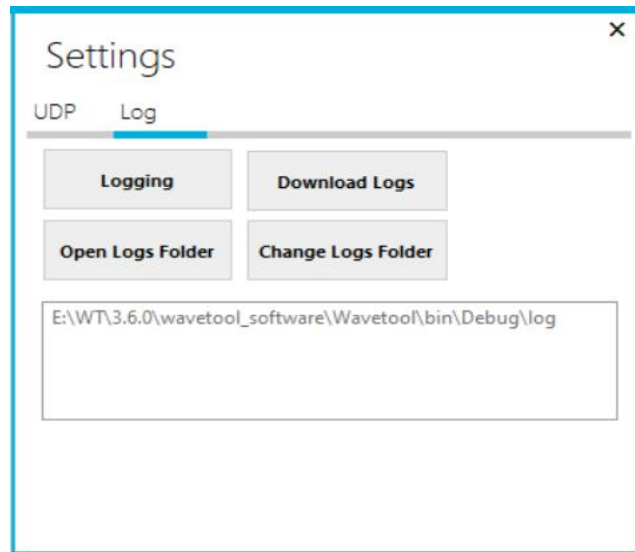


Figure 45: Logging Settings in Main window

- Select what will be logged and enter a use ID which will be stored in summary file for reference
- Turn logging on in the view.

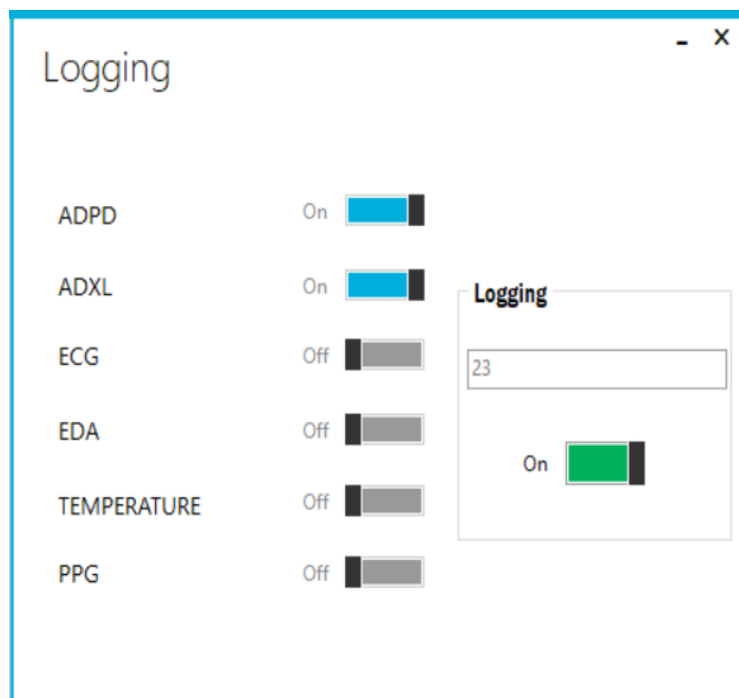


Figure 46: NAND Flash Logging Settings

3.7.2 Retrieving data from NAND Flash

Assuming data is logged into the NAND flash in the watch, follow the below steps to retrieve the data from the NAND flash

- Connect the watch to the Wavetool via USB
- Open Wavetool Software Main window
- Go to Settings → Log → Download Logs
- Select the relevant Log file to download
- Click on 'Get Log' to save the log to the PC
- Click on 'Open Logs' to open the folder where the logs are stored on the PC
- The m2m2 file is the log file that was retrieved from the firmware
- The CSV and JSON files folders contain equivalent files generated from the M2M2 file in the Wavetool.
- Click on 'FS Clear' to clear the logs on the NAND Flash
- Click on 'FS Reset' to reset filesystem. Note that this will clear all logs on the NAND Flash

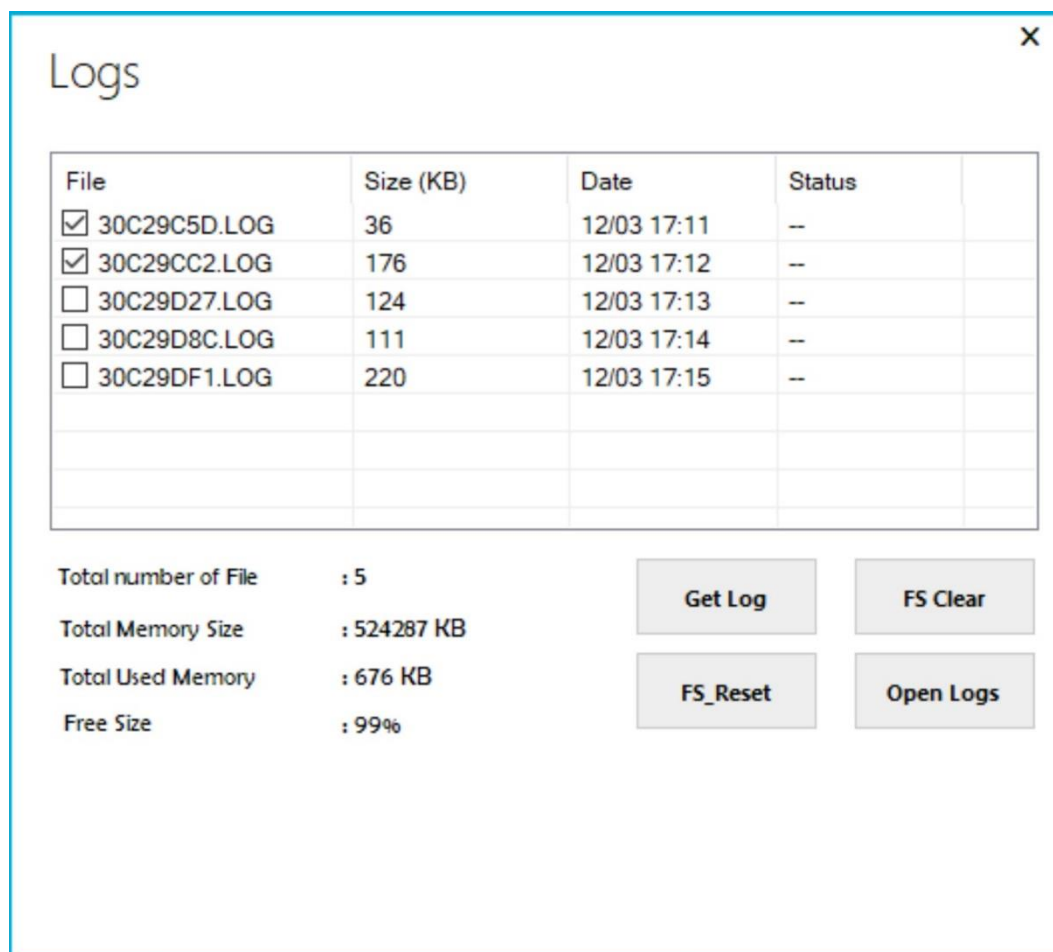


Figure 47: Download Log from NAND Flash

4 FAQs

4.1 What happens when a connection fails?

If the connection fails, then the following alert will be displayed

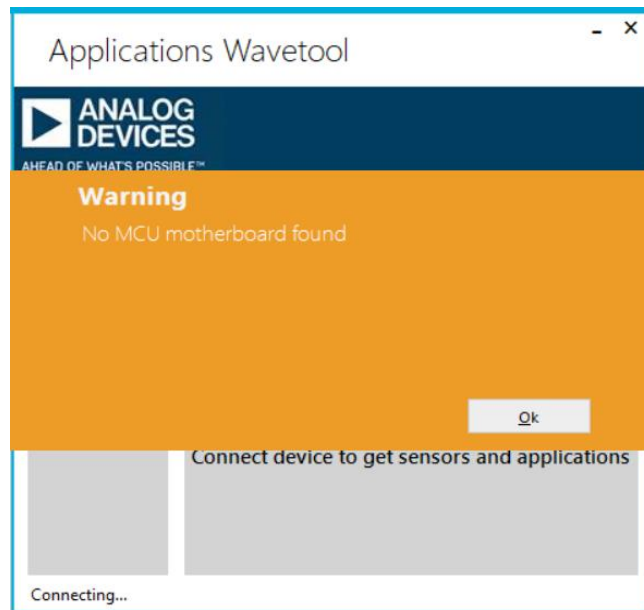


Figure 48 : Connection Failed

If BLE doesn't respond, then the following alert will be displayed

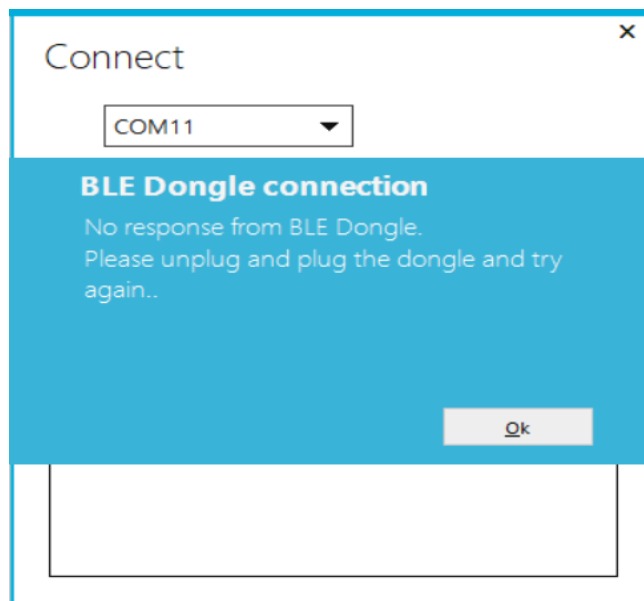


Figure 49 : BLE Connection Failure

4.2 Can I stream data when NAND flash logging is enabled?

Yes. We can stream the data when NAND flash logging is enabled

4.3 What are the restrictions of streaming data using BLE?

The maximum rate that can be streamed over BLE is 7.9KB/sec. Any configuration to run more than that rate will result in packet loss.

4.4 How do I change the Filter settings in JSON file?

To change an existing filter property, edit the '`<WAVETOOL_INSTALL_FOLDER>\etc\FilterConfig\FilterType.json`' file.

'*FilterName*': Some specific name for the filter to be listed in the dropdown of the Wavetool FilterType options

'*PassType*': Type of filter such as MOVING_AVG, DELAY, BPF, LPF, BIQUAD. Currently these are the only filter types supported in the Wavetool.

'*LowFrequency_3db*': This is the Low frequency cut off of the LPF and BPF filters

'*HighFrequency_3db*': This is the High frequency cut off of the BPF filter

4.5 How to flash firmware when firmware update gives the warning “Target not found”?

1. Select the watch COM port. Right click and select properties as like in the below image

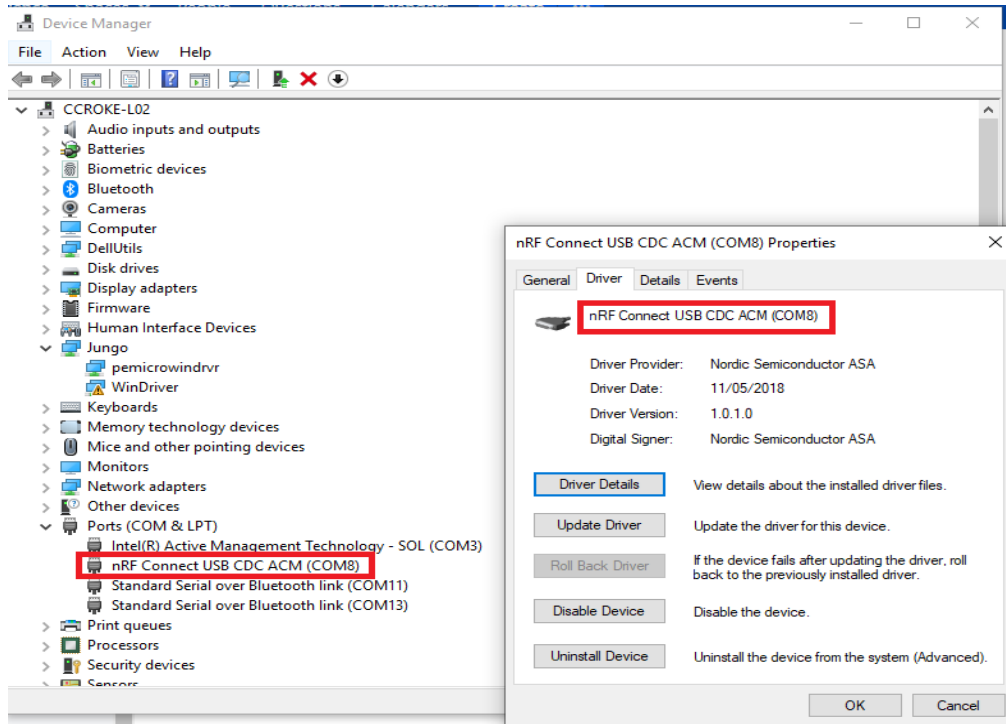


Figure 50 : Watch COM port properties

2. Select Driver and click Update Driver

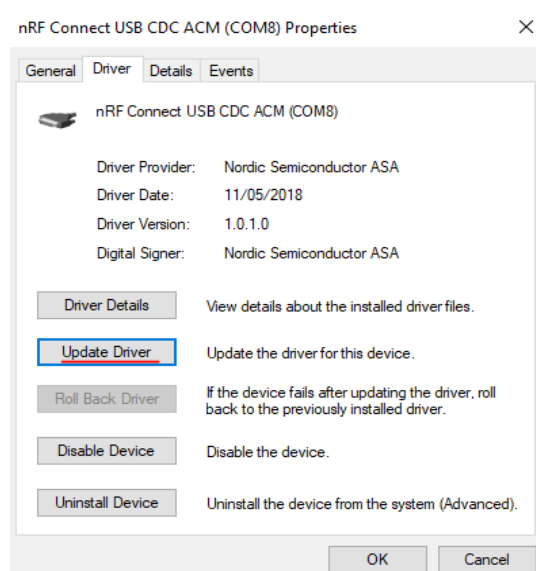


Figure 51 : Update driver

3. Select Browse my computer for driver software

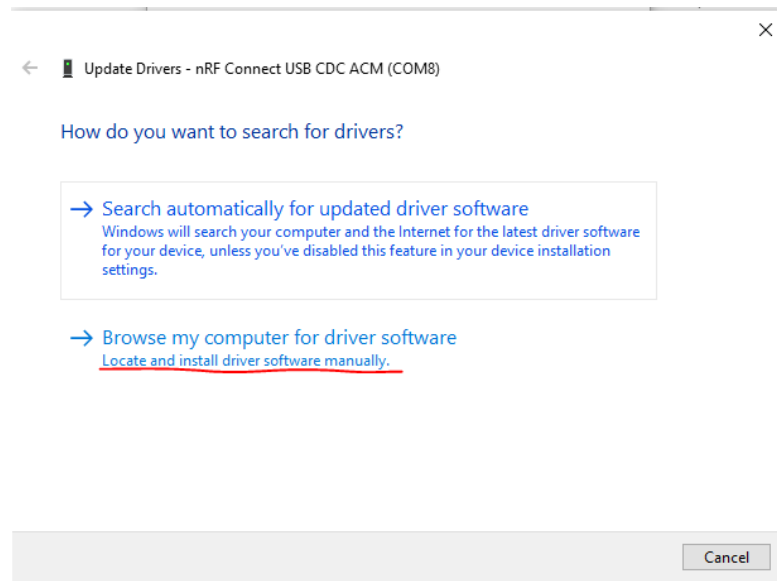


Figure 52 : Browse driver software

4. Select let me pick from a list of available drivers on my computer

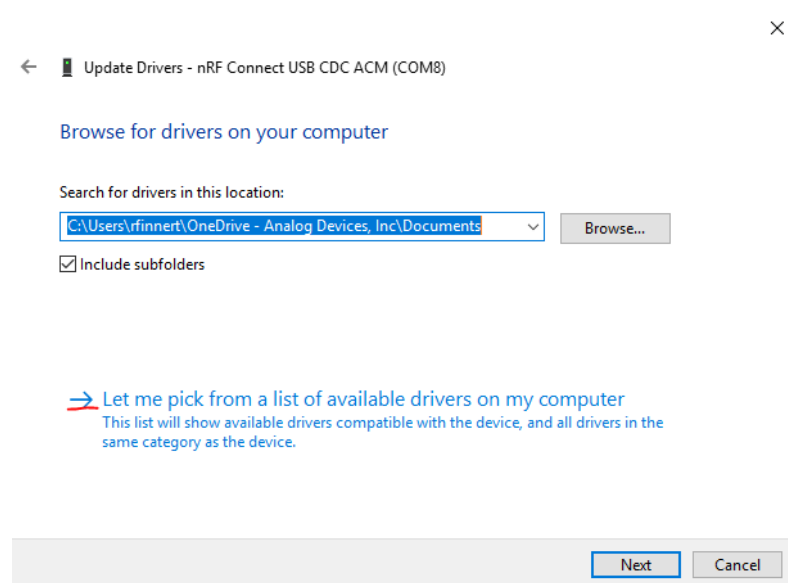


Figure 53 : Pick the available driver on computer

5. Deselect Show compatible hardware and select Nordic Semiconductor ASA, then from the Model select nRF Connect USB CDC ACM and click Next to update the driver

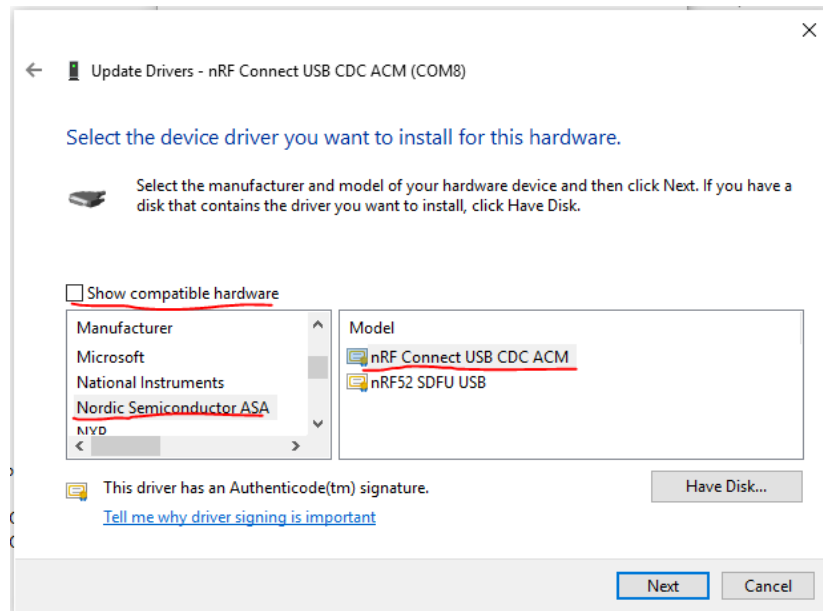


Figure 54 : Install the driver

6. Do the firmware update again

Terminology

Table 2: Terminology

Term	Description
FW	Firmware
BLE	Bluetooth Low Energy
PPG	Photoplethysmography
ECG	Electrocardiography
SPO2	Saturated Peripheral Oxygen
ODR	Output Data Rate
MCU	Micro Controller Unit
AGC	Automatic Gain Control
HRM	Heart Rate Measurement
MIPS	Million Instructions Per Second
LT	Low Touch Application

References

Table 3: References

Reference No.	Description
[1]	ADI_ADPD_Multimode_API_Reference.chm
[2]	Applications Wavetool
[3]	ADPD_MultiParameter_ReleaseNotes.pdf