OmniBlast™ Water Operation Instructions

REV00 – May 30, 2024

For Questions, please call: Kyle Willens – 775-781-3539

I. Specifications

This document serves as the instructions for operating an OmniBlast™ Water Generation 01 Sensor. The Generation 01 key specifications are listed in **Table 1**.

Table 1. OmniBlast™ *Water* Generation 01 Description

Battery Life	Sampling Rate	Blast Event Capacity	Pressure Range	Trigger Pressure (minimum)	Event Recording Duration
24 hours continuous	667kHz	5,000 events	0.5 – 1,000 psi (Channel 1) 0.5 – 100 psi (Channel 2) 0.5-100 psi for in-air sensor (Channel 3)	1 psi	25 ms

II. Operation of OmniBlast™ *Water* Sensors

The following will provide details for turning on, installing, downloading data, and turning off an **OmniBlast™ *Water*** sensor.

1. **Overview**: An OmniBlast™ *Water* sensor, demonstrating the locations of the underwater and in-air blast sensor locations, is shown in **Figure 1**. A customizable housing with various attachment method encloses the body of the sensor that has a power button, magnetic USB connector for data and charging, status light, and QR code (serial number). The omnidirectional underwater blast sensing element is at the exposed tip of the sensor. An in-air blast sensor is also integrated. Defined status lights are listed in **Table 2**.

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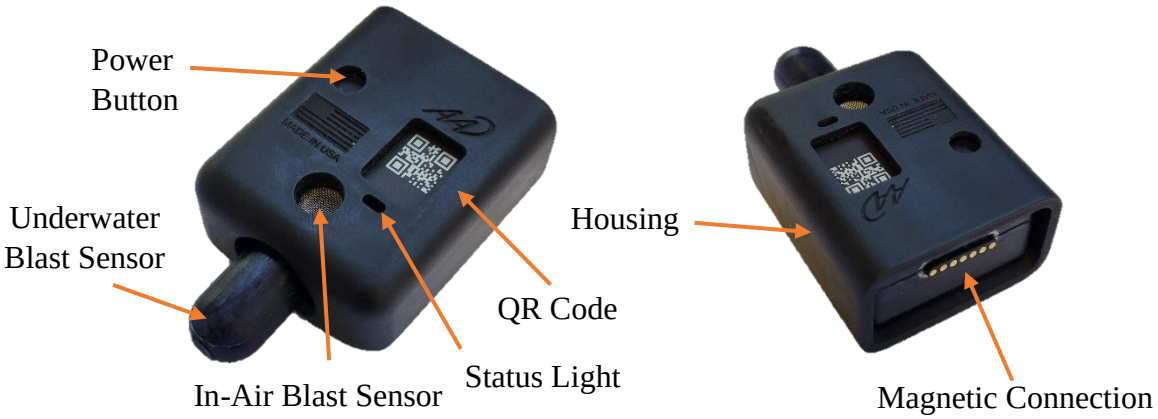

Figure 1. OmniBlast™ *Water* Generation 01 sensor.

Note: *The sensors are shipped with the status light enabled. If it is desired to turn the light off except on a button press to show the battery level, the status light can be turned off with the OmniBlast™ Sensor Manager mobile software. See Section 3: OmniBlast™ Sensor Manager.*

Table 2. Status Light Definitions.

Status Light Color and Sequence	Expected Command or function
Green, solid, 15 seconds	Booting up from sleep
Green, yellow, or red light flashes every ten seconds	Indicates battery level: Green = above 75% battery life Yellow = above 25% battery life Red = below 25% battery life
Yellow -Yellow	The clock/date is not synced
Flickering Green	Recording blast event to memory
Flickering Blue	Compressing recorded blast event file
Fading Red	Charging, not connected to a PC (wall charger)
Fading Cyan and Red	Connected to a PC and charging
Solid Cyan	Connected to a PC and fully charged
Blue - Blue- Green	Connecting to Bluetooth
Blue – Blue - Red	Disconnecting from Bluetooth

a) Power Button: the power button can be pressed, or "clicked" (for less than one second), to show the battery level on the indicator light. This can be pressed if the sensor is sleeping or awake.

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b) **Turning on**: To turn an OmniBlast™ *Water* sensor on from "button sleep" which is used for shipping or times when the user does not want the sensor to wake up upon movement, ***hold the power button for more than 1 second***. The indicator light will show the battery level color for one second, ***then flash Cyan three times when waking up***. If the power button is held for less than one second, "clicked", the battery level will show on the status light.

c) **BOOTING*:*** When the sensor wakes up from "button sleep" or from inactivity sleep (no movement detected for longer than the defined sleep threshold), ***Upon powering up, the indicator will be green for 5 seconds*** as the sensor self-calibrates. ***If the sensor detects) the clock/date (the real time clock (RTC)) is out of sync, the sensor will blink yellow twice after the 5-second green*** **calibration light. Connect the sensor to the mobile application to correct the date/time.**

d) **Status Light:** ***The status light can be disabled with the OmniBlast™ Sensor Manager (see section 2) if desired.*** When the status light is enabled, after calibration, the status light will blink every 10 seconds the battery level color to indicate the battery level and that the sensor is on. If the indicator light flickers green, then the sensor is recording a blast event. ***If the RTC is out of sync, there will be a double yellow light blink after the ten-second battery level indicator status light***. If the RTC is out of sync, the sensor must be connected and disconnected to the OmniBlast™ Sensor Manager (see section 2) to sync the time. If the time is not synced, the sensor will perform as usual, only the timestamps on events will be inaccurate.

e) **Sleep and Wakeup:** The sensors will automatically enter a low-power sleep mode when no movement is detected for longer than the sleep timer. ***The sensors are shipped with a 60-minute sleep timer***, but this can be adjusted or the sensors can be configured to never sleep, using the OmniBlast™ Sensor Manager. When movement is detected again, the sensors will wake up and show a green light for 5 seconds while booting up. The sensors can be forced to sleep, called "button sleep", by holding the power button for three seconds or more. In "button sleep" mode, the sensors can only be woken up by holding the button. When forcing the sensors to sleep, they will flash the battery ***level color while the button is held, then followed by Cyan three times. Hold the button until the Cyan light blinks three times then let go to force the sensor to sleep.***

f) **Obtaining Data via USB**: To download data from OmniBlast™ *Water* sensors via USB, connect the sensors to a computer with the provided USB-magnetic connector cable. When the sensors are plugged in, the status light will fade to Cyan and red if connected and charging. The status light will be solid Cyan if connected and the sensor is fully charged. On a Windows PC, the sensor will show up as OMNIBLAST™ in the file explorer (**Figure 3**). Click on OMNIBLAST™ in the file explorer to list the files recorded on the sensor.

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Each file is numbered in the order they were recorded. The files can be directly copied and pasted from here. ***Note: The Files are in .GZ format (compressed binary files). These must be parsed (converted to human readable ASCII text) using AMAD's PC-based OmniBlast™ Processor, see Section 3.***

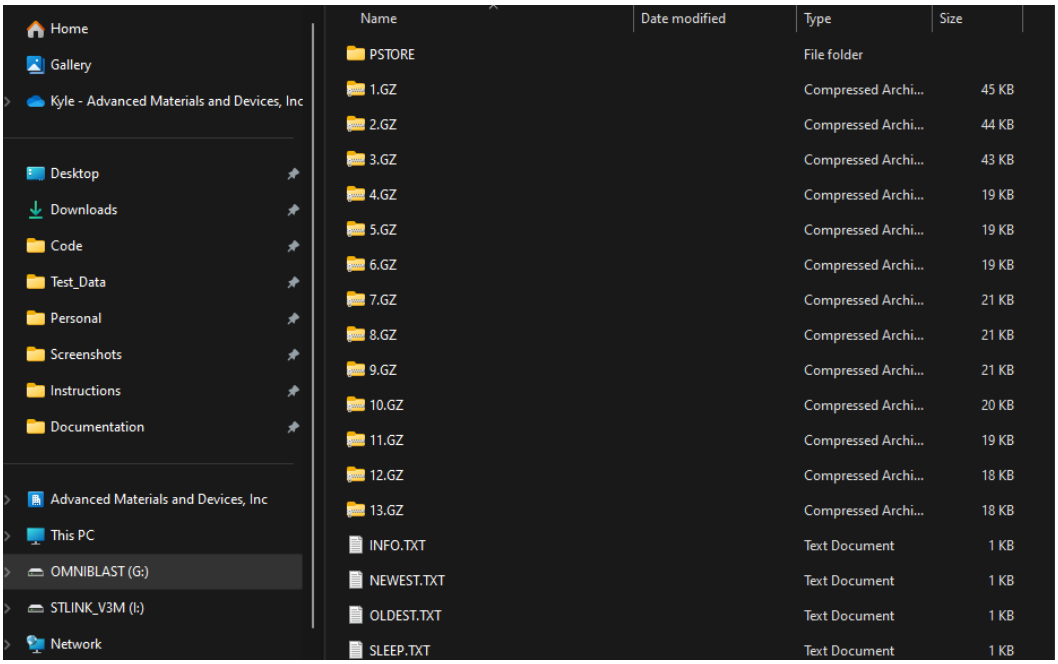

Figure 3. Files recorded on an OmniBlast™ *Water* found in the Windows file explorer.

g) Obtaining Data via Bluetooth: ***To download data from OmniBlast™ Water sensors wirelessly, use the OmniBlast™ Sensor Manage mobile application, (See Section 3).*** The parsed files (used for analysis in the application) can be obtained by plugging the Android device into a PC and navigating to: This PC -> Android Device Name->OmniBlast™Manager->Sensors->SensorSerialNumber->ParsedFiles.

h) Troubleshooting:

1. **Sensor does not turn on:**
   - **a)** Holding the power button for 1 second to ensure the sensor is not in "button sleep" mode.
   - **b)** If (a) is not successful, plug the sensor into a wall power charger and look for a fading red light. If a fading red light is observed, let the sensor charge up. Then unplug the sensor and see if the ten-second status light is blinking every ten seconds.
   - **c)** If (a) or (b) do not work, reset the sensor by holding the power button for 8 seconds, then release the button and observe if a successful boot sequence occurs Red light (0.5 seconds)->2 seconds no light delay->Green Light for 15 seconds).

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2. **Sensor shows solid color light, and will not stop:**
    - **a)** Press (click) the power button once
    - **b)** If the power button click does not solve it, reset the sensor by holding the power button for 8 seconds, then release the button and observe if a successful boot sequence occurs Red light (0.5 seconds)->2 seconds no light delay->Green Light for 15 seconds).
3. **Sensor repeatedly blinks purple light:**
    - **a)** Press and hold the power button for 8 seconds and release. The sensor will reset.

4. **Date-time is not accurate in events.**
    - **a)** Make sure the sensors' time is synced before testing by connecting to the OmniBlast™ Sensor Manger (OSM), and then disconnect before the test events. If a double yellow light (yellow-yellow) is seen after the Green light boot sequence, or when the ten-second status light blinks, this indicates that the time is out of sync and must be connected to the OSM.

III. OmniBlast™ Sensor Manager

The following provides instructions on how to download the OmniBlast™ Sensor Manager (OSM) to an Android device and instructions on how to control OmniBlast™ sensors and retrieve data.

1. **Downloading**: To download the OSM to an Android device, connect the Android device to a PC and ***ensure the OSM_verion1.0.0.apk is available in a file location on the PC*** (in downloads, documents, desktop, etc.)
    - **a.** Select the Android device in the file explorer and paste OSM_verion1.0.0.apk into the downloads folder of the Android device. (**Figure 4**)

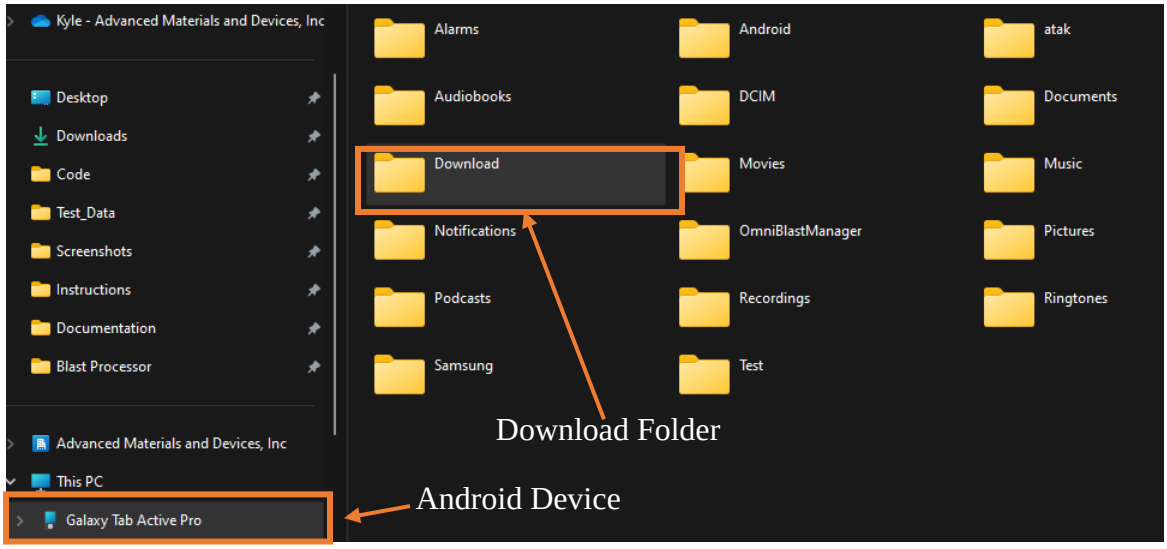

Figure 4. Android device connected to a Windows PC and displaying the download folder.

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b. On the Android device open the downloads folder and select the OSM_version1.0.0.apk. After selecting the file, a prompt to download the OSM will appear. Click Install. (**Figure 5**). ***Note: A prompt that says it won't download because of an untrusted source may appear. Click more options and "install anyway" if this is accepted.***

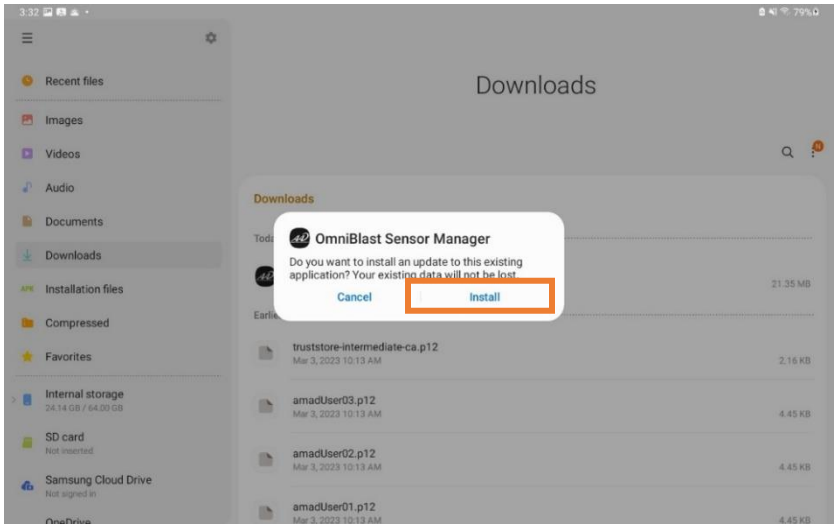

Figure 5. Selecting and installing the OSM .apk from the downloads folder.

c. Once downloaded, open the OSM and the main page will appear (**Figure 6**).

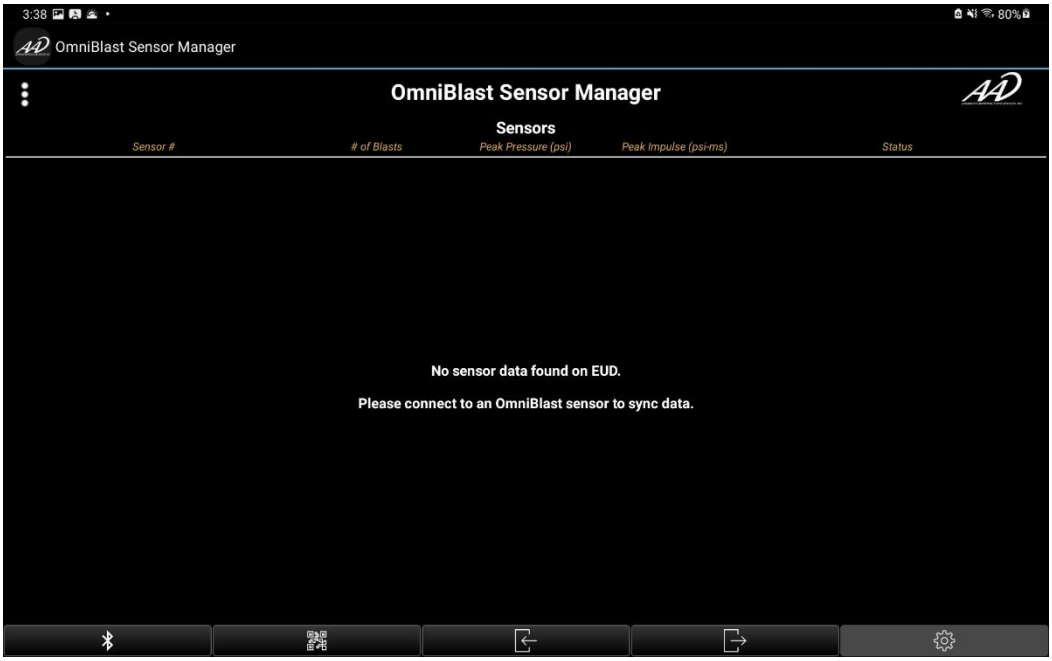

Figure 6. Main page of the OSM on a new installation.

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2. **Navigation**:
   a. One can scan for OmniBlast™ sensors that are powered on and awake by selecting the Bluetooth button (**Figure 7**)

Figure 7. Bluetooth button in the OSM.

   b. If OmniBlast™ sensors are found available via Bluetooth, they will be displayed (**Figure 8**)

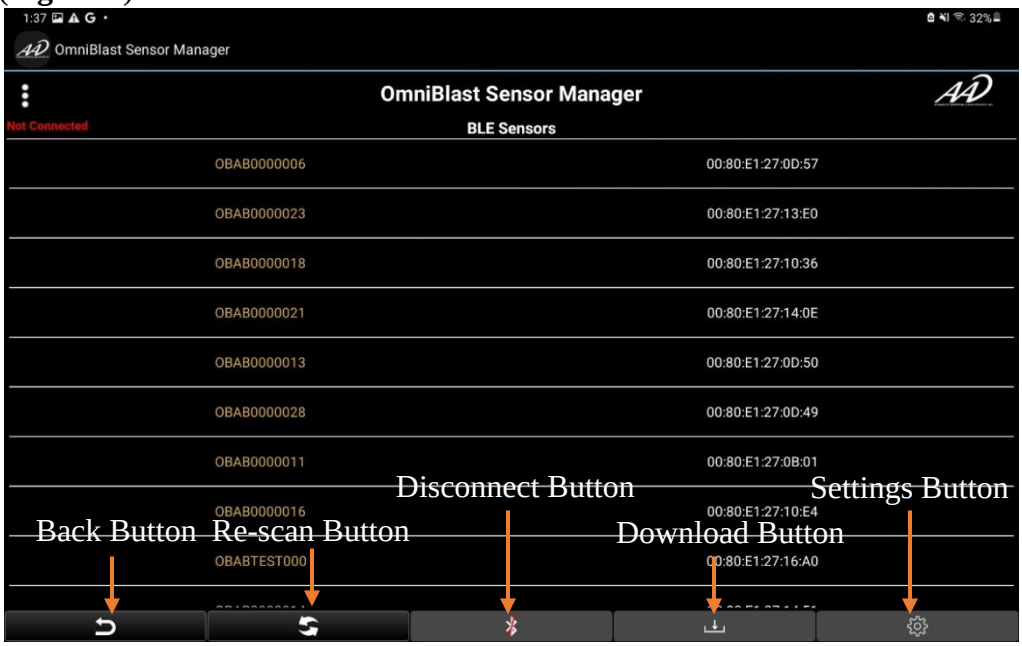

Figure 8. Available sensors listed on the Bluetooth page of the OSM.

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c. One can connect to a sensor by selecting one. If events are on the sensor, it will ask to pull them (**Figure 9**). One can pull the files now or pull them at any other time by selecting the download button when connected to a sensor (**Figure 9**). After selecting "pull", the files will begin to sync (**Figure 10**). After all files are synced, the main page will open, and event data can be accessed.

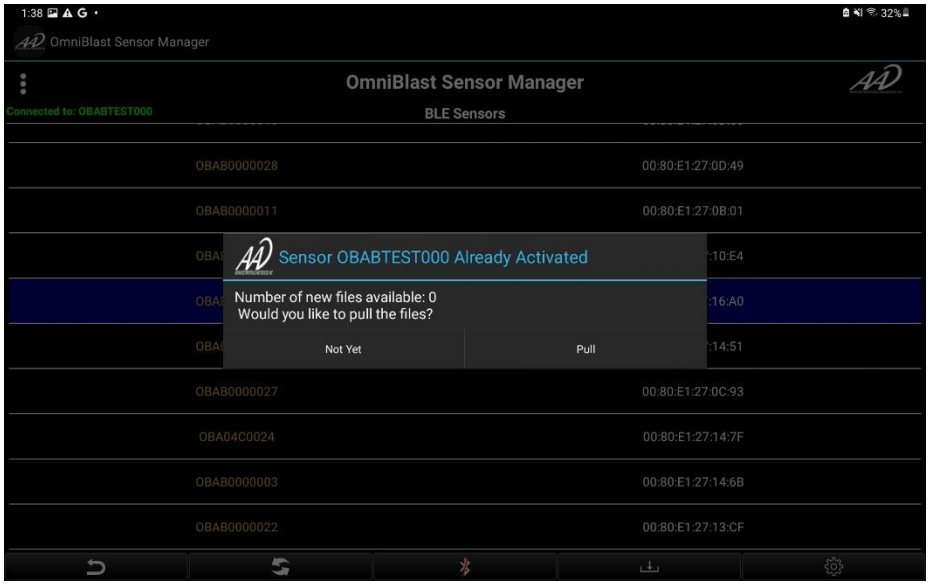

Figure 9. Prompt to pull files after connecting to an OmniBlast™ sensor.

Figure 10. Syncing files with the OSM.

d. ***Time Syncing***: When connecting to a sensor, the time is synced. To only sync the time, disconnect from the device after connection by using the disconnect button (**Figure 9**).

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e. **Settings:** When connected to a sensor, the settings button can be clicked to apply settings**. The settings menu will popup (Figure 11).** ***Note: All settings can remain unchanged or "unset" and it will not affect the sensor's operation. For example, not setting the User Id will list "None" in the event headers.***

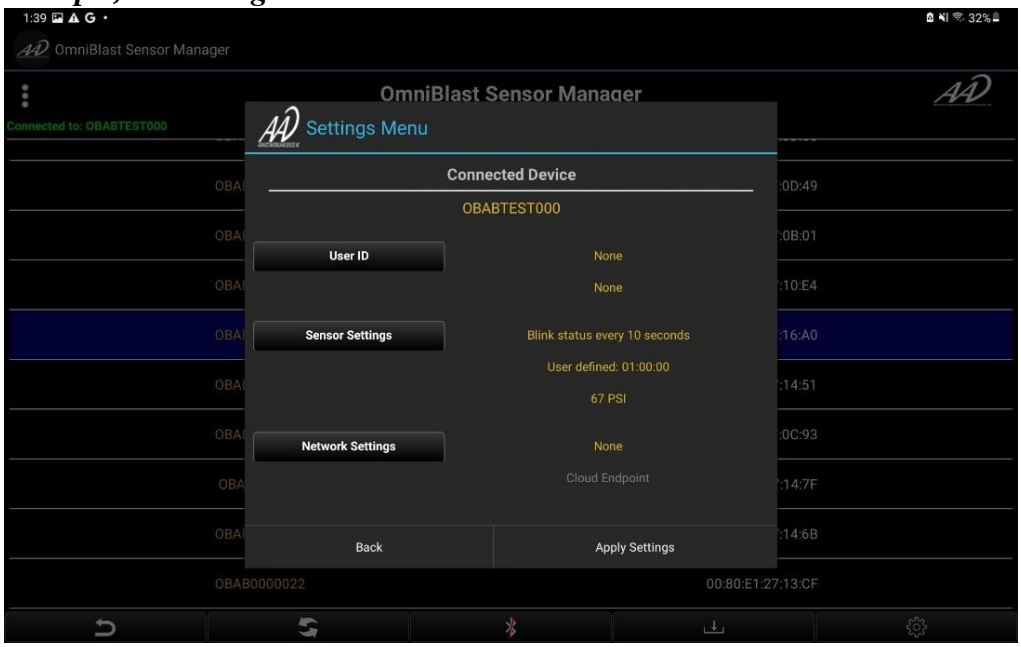

Figure 11. Settings menu of a sensor connected to the OSM.

f. **User Settings:** Selecting User ID in the settings menu will show the user settings where one can assign an ID and installation location to a sensor. (**Figure 13**).

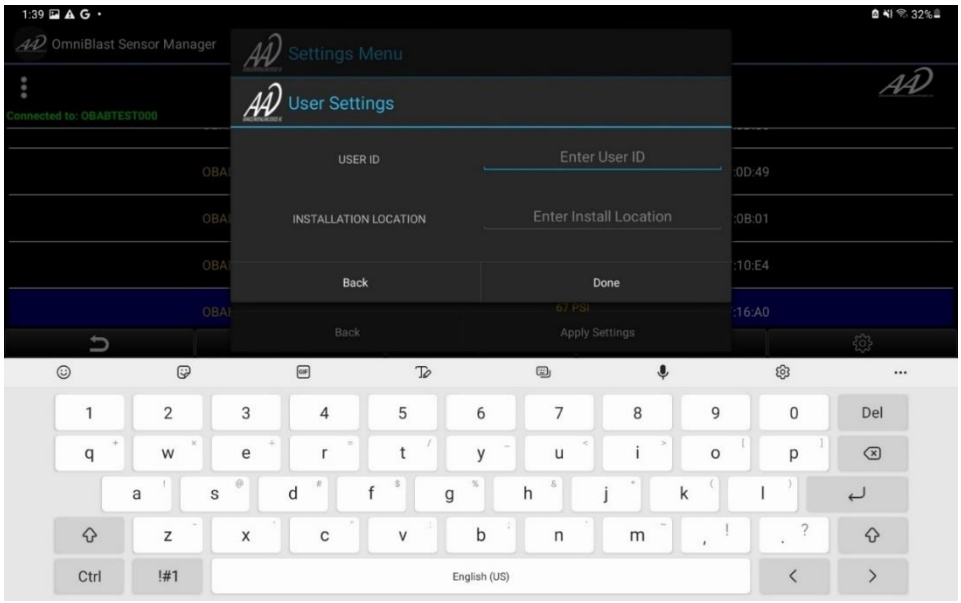

Figure 13. User settings that can be applied.

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g. **Sensor Settings**: Selecting the sensor settings in the settings menu will show the sensor settings menu. The lighting scheme, sleep timer, and blast trigger pressure can be adjusted here (**Figure 14**). ***Note: the sensor can be set to "No Sleep" if it is being tested on structures or similar, where there will not be any movement for long periods of time. Also, the lighting scheme can be set to "Default: all off" which will ensure the sensor does not shine any lights except if the power button is pressed to show the battery level "health check."***

Figure 14. Sensor settings that can be applied.

h. **Network Settings**: For the OmniBlast™ *Water* sensors, network settings will not affect anything.

i. **Applying Settings**: After all desired settings are entered, select Apply Settings on the settings menu. The sensor will reboot.

j. **Data Analysis**: To view data pulled from sensors, go to the home page. If the Bluetooth page is selected, click the back arrow to go to the home page. Sensors with events that have been pulled to the OSM will be listed (**Figure 15**) Select a sensor to see the events (**Figure 16**). Selecting an event gives the option to plot data (**Figure 17**). Select "Pressure" to plot the pressure history of an event (**Figure 18**). Select "Acceleration" to plot the acceleration history of an event (**Figure 19**).

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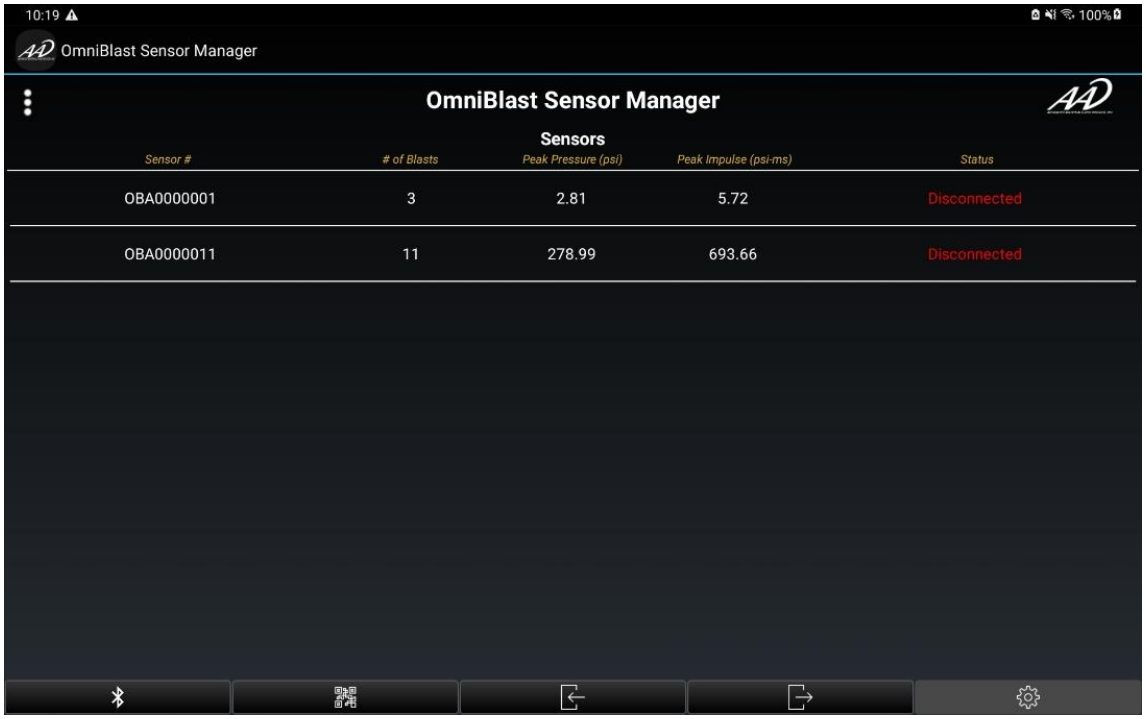

Figure 15. Main page listing sensors that have data on the OSM.

Figure 16. List of events a sensor has on the OSM.

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Figure 17. Selecting and event gives the option to plot the data.

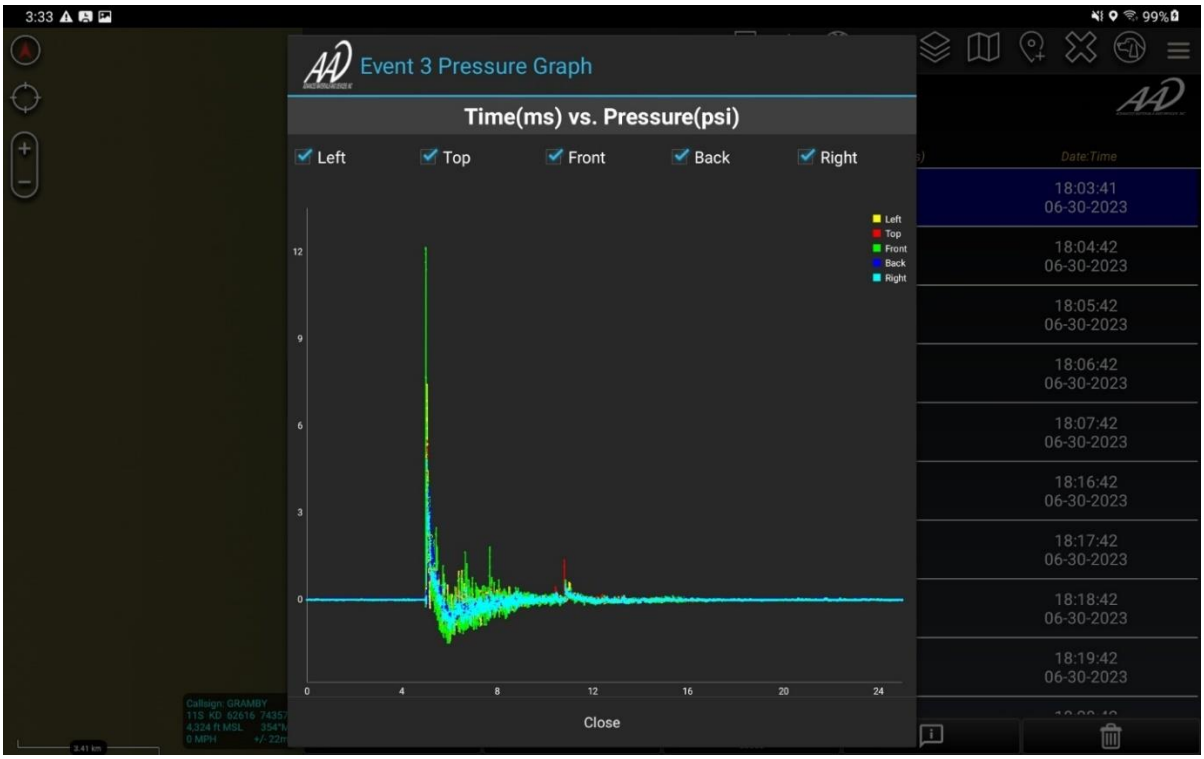

Figure 18. Example of a pressure history plotted with the OSM.

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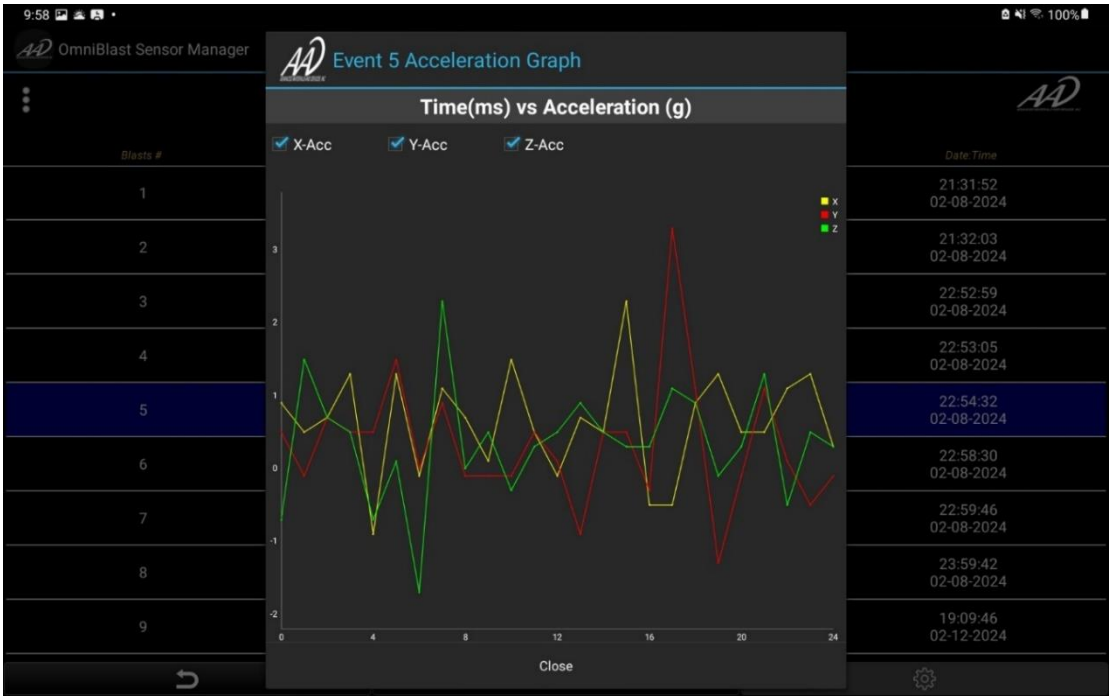

Figure 19. Example of an acceleration history plotted with the OSM.

k. Raw Data Files: To access parsed event files stored on the Android device, with the Android device connected to a PC, navigate to: This PC -> Android Device Name->OmniBlast™Manager->Sensors->SensorSerialNumber->ParsedFiles (**Figure 20**).

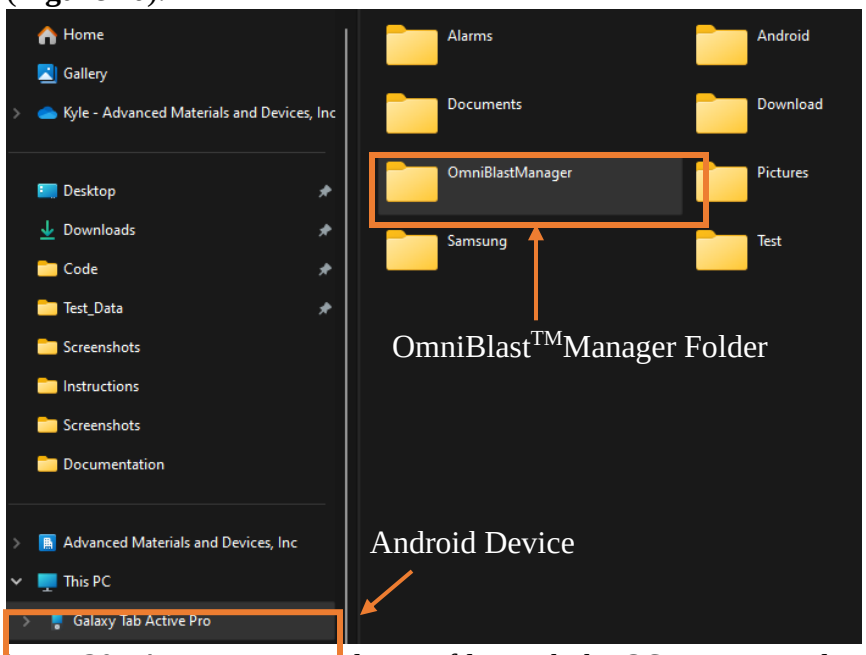

Figure 20. Accessing parsed event files with the OSM connected to a PC.

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IV. OmniBlast™ Processor (PC-Based Software)

The following provides instructions on how to use the OmniBlast™ Processor to parse event files and process data from an OmniBlast™ Water.

1. **Downloading**: To download the OmniBlast™ Processor, use the OmniBlast™.Processor.Installer.exe installer and follow the instructions to download the software. The default installation location will be /Program Files/OmniBlast™_Processor.

   If there are issues using the installer to download the software, request the software .exe from AMAD to see if that will run on the PC.

2. **Navigation:**

   a) The OmniBlast™ Processor creates a default "Main Test Folder" at the installation location/Test_Data. One can select any other location for "Main Test Folder" by selecting the folder icon or typing into the text box (**Figure 21**).

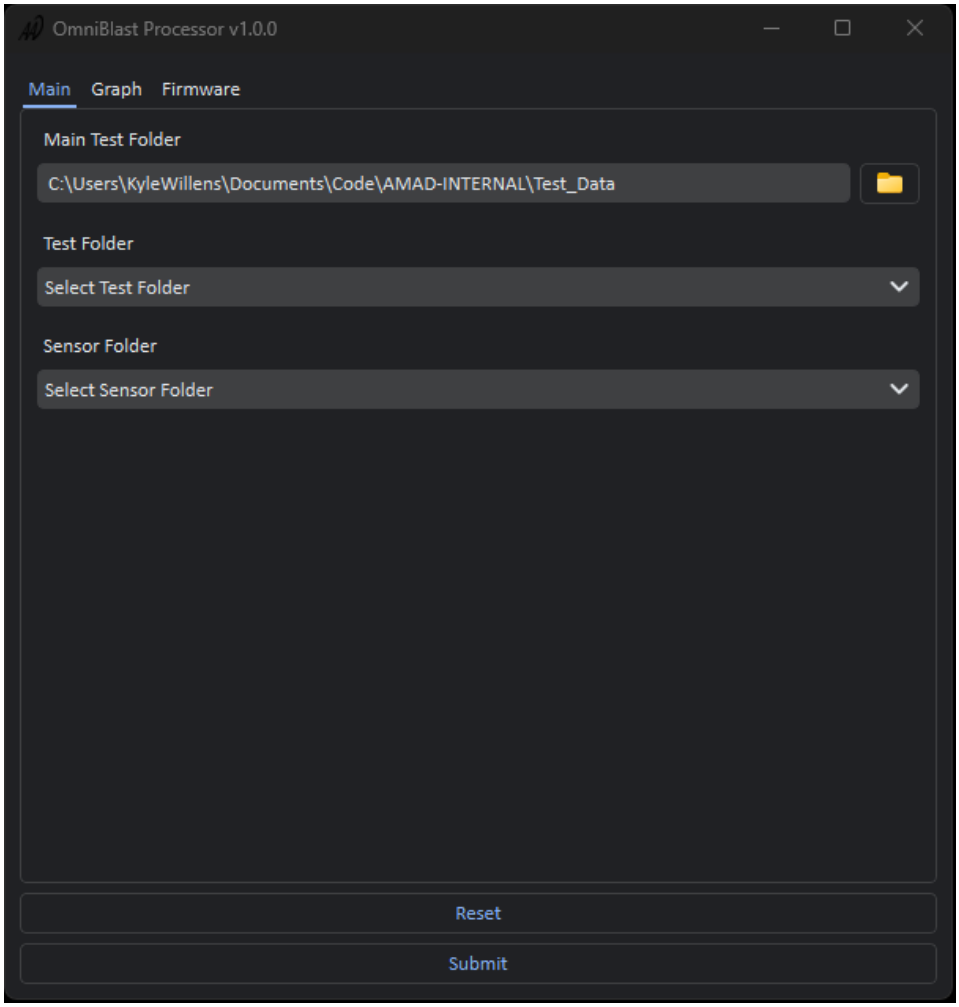

Figure 21. OmniBlast™ Processor main page.

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b) Data copied from OmniBlast™ Sensors must be stored in the structure below to be processed. The file structure is:

Main Test Folder / Test Folder / Sensor Folder

For example, the main test folder is typically where a user will store all data from OmniBlast™ sensors. The "Test Folder" can be structured by dates or other identifiers, and the "Sensor Folder" is typically the sensors serial number. In **Figure 22**, it shows the "Test Folder" was selected as 1-30-24 and the "Sensor Folder" was selected as OBAB00000011. ***When copying data from an OmniBlast™ Sensor, create a sensor folder matching the sensors serial number (it is not required to name this sensor folder the serial number, but it is recommended.) Copy the .GZ event files to the sensor folder. for example, the 1.GZ event would be placed in: Main Test Folder/Test Folder/Sensor Folder/1.GZ***

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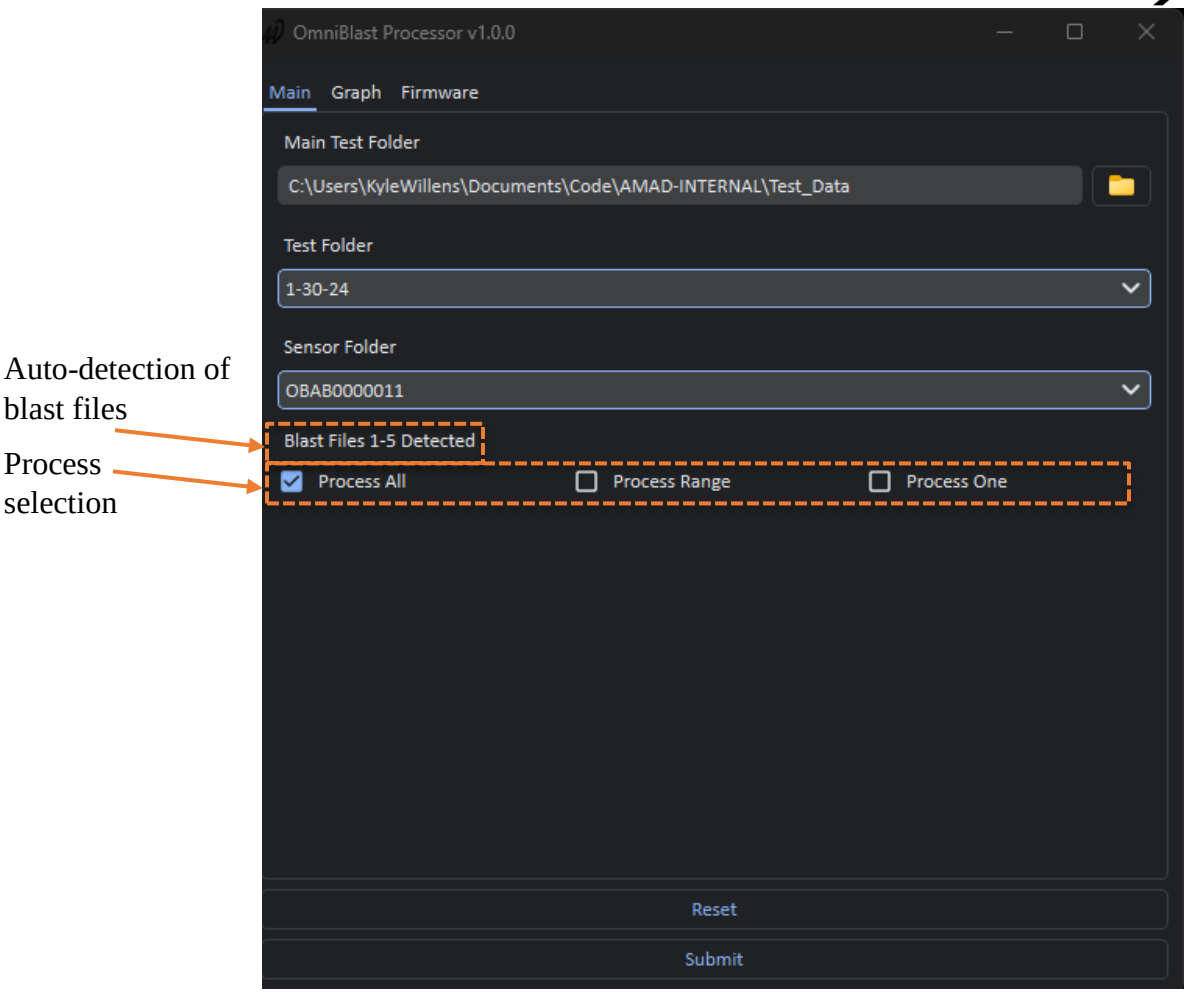

Figure 22. Selecting the Test folder named a date and a sensor folder named a serial number and the auto-detection of blast events in the folder with a process selection.

c) Once the sensor folder is selected, the OmniBlast™ Processor will identify if blast events are in the folder (**Figure 23**). One can select process all, process range, or process one to either process all the detected files, a range of detected files, or a single selected file, respectively.

d) The "Graph" tab is used for processing options. In the Tab, the default checked selections are Graph, ACC, and Excel Table. This means, the processed data will be graphed, acceleration histories will be graphed, and an excel table summarizing the events will be created. One can un-select any item to disable its function. The default unchecked "Offset" can be checked offset each of the OmniBlast™ pressure signals in the graph, as opposed to overlayed. (**Figure 24)**.

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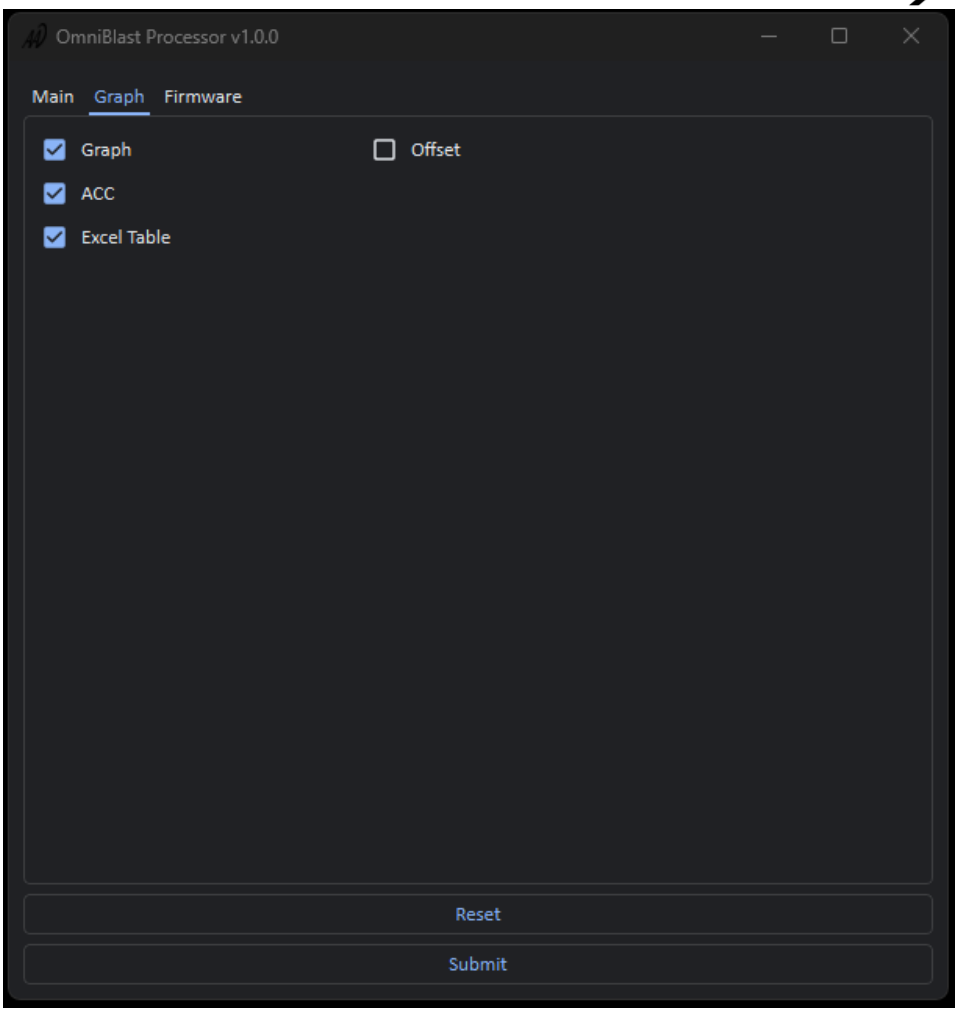

Figure 23. The graph tab has options for how to process and display the data.

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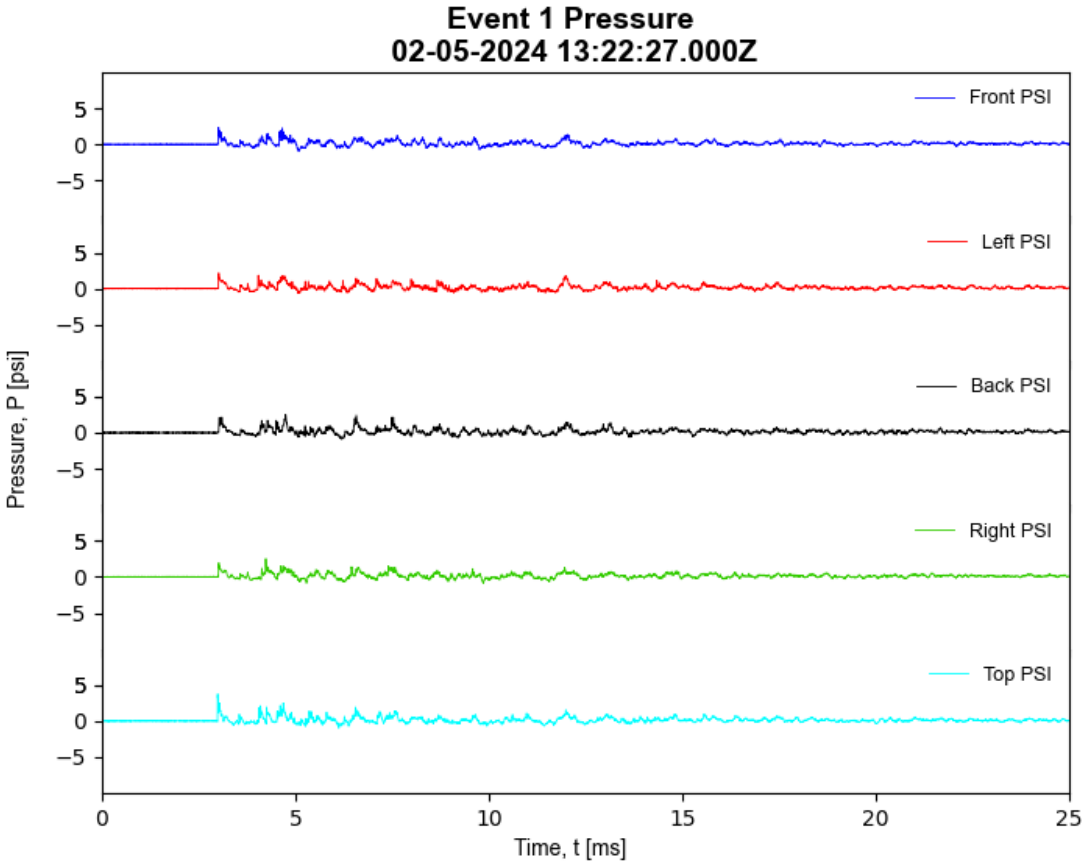

Figure 24. Selecting the offset option will create offset pressure history graphs.

e) Process Data: Click the Submit button on the to run the selected data files with the settings selected on the graph tab (process all, process range, or process one options).

f) Obtain Parsed Data Files: After running the data, the parsed data files are located in: **Main Test Folder /Test Folder / Sensor Folder /parsed_data**

There will be .txt in human readable ASCII text (**Figure 25**) of the processed events. These can be used for independent analysis. NOTE: For each data section, (acceleration, IMU acceleration, IMU rotation, magnetometer, pressure) there is a sampling rate descriptor. For example, the pressure readings begin on line 437 and on line 434, the descriptor says: ADCSampleRate[Hz]: 400000 (**Figure 26**). ***When analyzing the data, a time array using the sampling rate must be made where the time step is 1/sampling rate***. In the example of the pressure data, this is 1/400000 = 0.0000025s or 2.5microseconds. The time array should then be 0 through (length

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of pressure data) with timestep 2.5 microseconds, typically coded as: (0:0.0000025:0.0025).

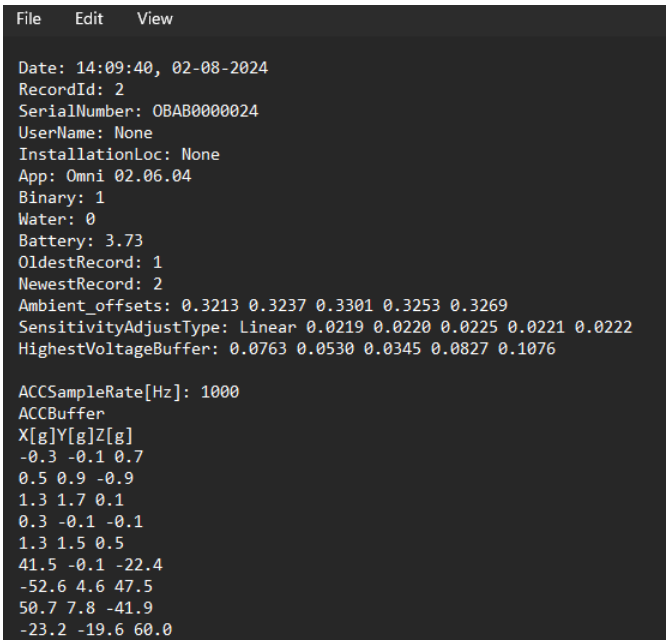

Figure 25. Example event header and beginning of data of .GZ file parsed to .txt

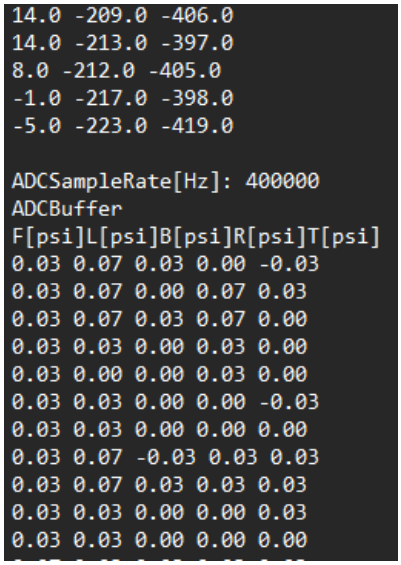

Figure 26. Example of the beginning of the pressure event data in the .txt parsed file.

g) View Processed data: After running the data, the processed data is located in:
Main Test Folder /Test Folder / Sensor Folder /processed_data
In the processed data folder, there is one folder named Graphs and one excel sheet (**Figure 27**) (assuming the Graph and Excel Table Checkboxes were not unchecked

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on the Graph tab) In the Graphs folder, there is a single pdf for all events and one pdf combining all events named Processed_Data (**Figure 28**). Selecting the Sensor_SerialNumber_Data.xlsx will bring open a table summarizing data from the processed events.

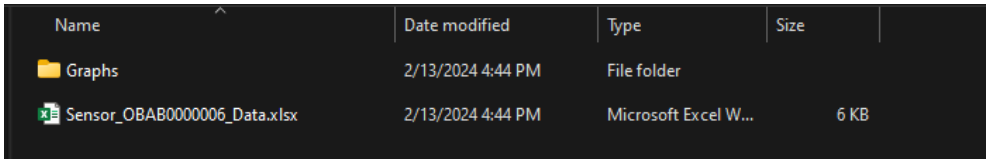

Figure 27. Processed data folder content and layout.

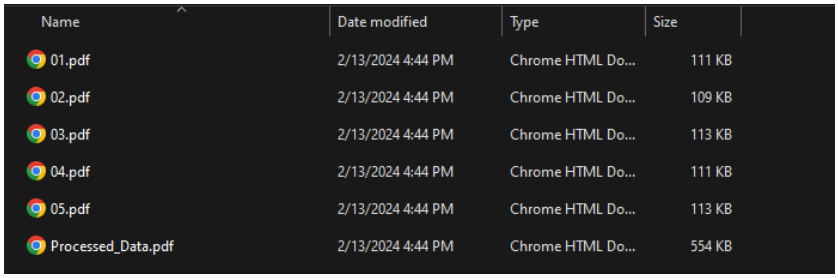

Figure 28. Graph folder contents and layout.

3. **Firmware Flashing:** The firmware tab (**Figure 29**) in the OmniBlast™ Processor is used for flashing firmware to sensors.
   - **a)** If there is a firmware update available, **obtain the new firmware file in the .bin format from AMAD.**
   - **b)** Copy the .bin firmware file to a location on a PC (can be any location such as downloads, documents, desktop, etc.)
   - **c)** Select the folder icon in the Firmware Tab (**Figure 31**) and navigate to the location of the .bin file.
   - **d)** Once a .bin firmware file is selected, and matches the correct firmware, the "Download Firmware to Device" is enabled (can be clicked)
   - **e)** **Place the sensor in Boot Mode**: Press and hold the power button for **15 seconds**. During the hold time there ***should not be any lights*** (blinking or solid) and when depressed, you ***should not see any lights***. If youdo, please repeat the button hold process.
   - **f)** **Connect the OmniBlast™ Sensor to the PC with a USB -magnetic connector cable**.
   - **g)** If the "Download Firmware to Device" without putting a sensor into "Boot Mode" is clicked, there will be a message "No OmniBlast™ Sensor in Boot Mode Detected" (**Figure 30**).
   - **h)** If a sensor in boot mode is detected by being connected over USB, the firmware will begin to download with the message "Downloading" (**Figure 31**).

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i) After the firmware has successfully been downloaded, the message will say "Firmware downloaded successfully" (**Figure 32**).

j) After the firmware has successfully been downloaded, the sensor will show a solid red light. ***Disconnect the sensor from the USB*** (On the sensor side, leave the side connected to the PC in the PC). ***Swipe (not hold) the magnet across the sensor to reset it, then look for the proper boot sequence*** (red light for 0.5 seconds, no light for 2 seconds, green light for 5 seconds).

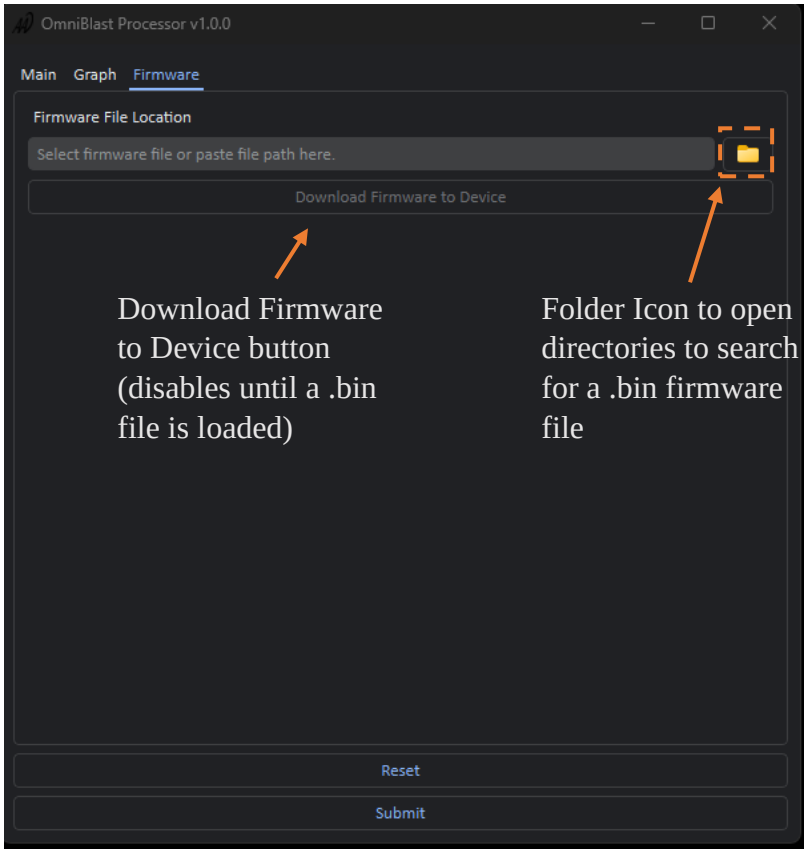

Figure 29. Firmware tab of the OmniBlast™ Processor.

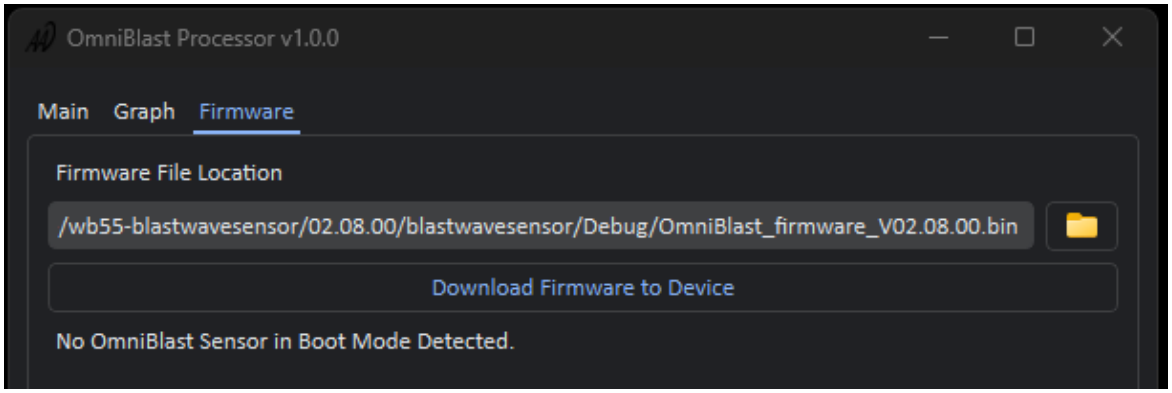

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Figure 30. Message of No OmniBlast™ Sensor in Boot Mode Detected if the click the Dowload Firmware to Device button is clicked when no sensor is connector in boot mode.

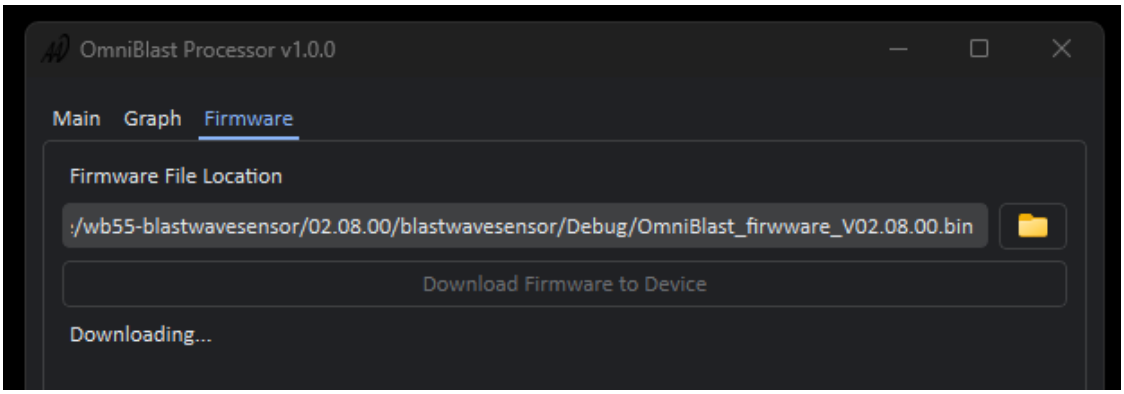

Figure 31. Message of Downloading while the firmware is successfully being downloaded.

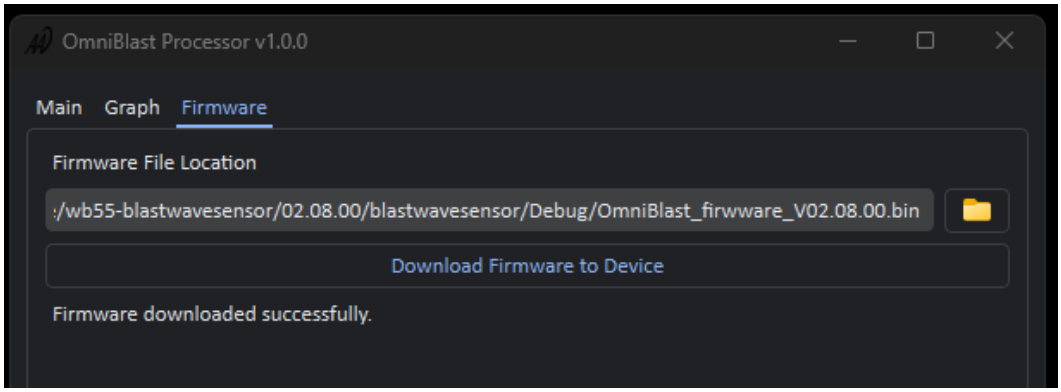

Figure 32. Final Message saying Firmware Downloaded successfully.

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