Smart Pi SPL

USER GUIDE

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Version: 2.1.0

CONTENTS

1. INTRODUCTION

Thank you for choosing Smart pi SPL.

Smart pi SPL provides a robust and professional standalone automated Sound Pressure Level (SPL)metering and monitoring system with configurable logging. Smart pi SPL complies with and surpasses mandatory government metering standards.

Smart pi SPL features dual simultaneous (and independent) audio inputs, with a web browser-based management system and an HDMI video display output. Smart pi SPL is compatible with any Class 2 microphone and allows for a measurement chain in accordance with IEC 61672-1 (IEC2013). Additionally, an optional MEMS (MicroElectrical-Mechanical System) microphone can be used with the unit. Built with power and simplicity in mind, Smart pi SPL allows the easy configuration of SPL monitoring, logging, and display parameters.

The device is simple to use and easy to calibrate. Certificates of calibration are generated and exported through the web management interface. Both SPL and calibration logs can be exported(.csv file format) for a configurable time period of up to 90 days. Additionally, Smart pi SPL can be configured for remote management access. An outdoor weather resistant unit is also available.
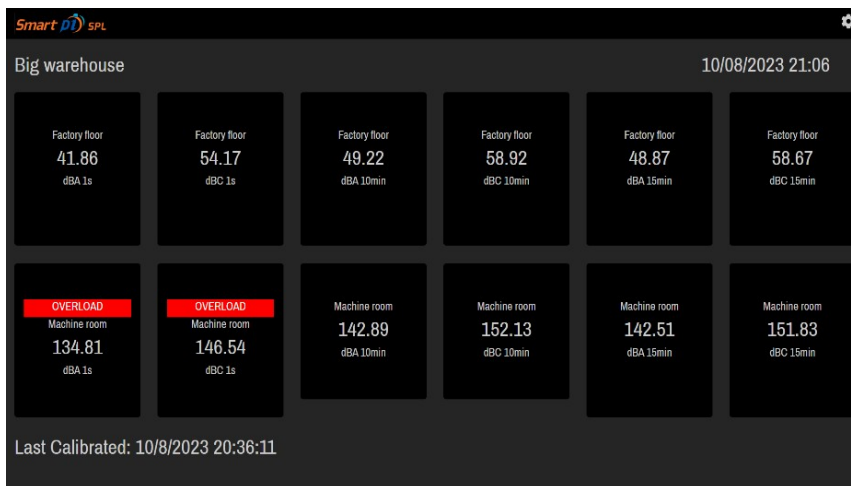
Example of a 'Display' featuring 6 time-based SPL measurements for each of 2 locations

Smart pi fitted with wi-fi antenna

Please read this manual before operating your new Smart pi SPL to ensure the safe and best practice operation of your unit that will last for years to come.
For more information enquiries are welcome at: info@smart-pi.info

2. FEATURES AT A GLANCE

Housing	Robust cast aluminium case (145 x 130 x 27 mm). Wall mountable
Audio input:	Two 3.5 mm TRRS audio jacks (front) with Class 2 pre-amps Recommended SPL microphone: MicW i436 (MicW 2018) One 2.5 mm TRS jack (MEMs microphone functionality)
Management	Local or remote (optional) web browser interface (up to 20 users)
Display output:	HDMI (2.0) (with HDCP)
Power	microUSB (5V DC 2A). Power supply is included with the unit
Connectivity:	Ethernet RJ45 10/100 Mb WiFi - 802.11n
Calibration	Via web browser with optional calibration device (not supplied) Recommended device: BWSA Tech Sound Calibrator CA114/115 (BWSA 2018)
SPL monitoring	dBA (LAeq) 1 sec Total 'A' weighted decibel sound pressure level per second dBA (LAeq) 15 mins Average 15 minute rolling 'A' weighted decibel sound pressure level dBA (LAeq) 60 mins Average 60 minute rolling 'A' weighted decibel sound pressure level dBC (LCeq) 1 sec Total 'C' weighted decibel sound pressure level per second dBC (LCeq) 15 mins Average 15 minute rolling 'C' weighted decibel sound pressure level dBC (LCeq) 60 mins Average 60 minute rolling 'C' weighted decibel sound pressure level Accurate logging up to 124 dB SPL
Logging	Logging period for SPL and calibrations can be set from 1 to 90 days All logs downloaded-able in CSV format via web management interface Remote logging option available
Updating	w updates can be applied via the web management interface
Backup / Restore	SMART SPL features a total backup and restore facility for all system settings and logging data

3. HARDWARE OVERVIEW

Smart pi SPL features a strong die cast aluminum casing which is wall mountable.

The Smart pi SPL front panel

The Smart pi SPL rear panel

4. SETTING UP

Check and open the packaging carefully. Please make sure all accessories are present.

The Smart pi SPL box will contain:

· 1 x Smart pi SPL unit

· 1 x Power Supply with microUSB cable

· 1 x Wireless antenna

· 1 x Quick start guide

The casing has two mounting holes in the side brackets to allow mounting on a flat surface, such as a wall or ceiling. To remain within warranty, please install the unit in a dry area that is not subject to extreme heat. A well ventilated area is ideal. Importantly, take care that the mounting position allows for clear access to the front and rear panels of the unit.

> **Never remove the outer casing of the Smart pi SPL. Doing so may pose an electrical safety risk and may void your warranty. Please also be aware that any modifications made to the unit will void your warranty.**

> **Before commissioning, your Smart pi SPL must be calibrated with the specific microphones that you have chosen for your setup. This is absolutely critical for compliance with environmental sound level monitoring legislation. See section 6 for the calibration procedure.**

Make your cable and microphone connections. An Ethernet network connection and IT network infrastructure is essential for operation.

Power on the device

Smart pi SPL will initialise, acquire a network address and the first run Wizard will begin.

4.1 FIRST-RUN WIZARD

The first-run Wizard will launch to take you through setting up Smart pi SPL for the first time.

After powering up, the unit will obtain an IP address from your local area network. The address should be known by your network administrator.

With your preferred web browser, access the web management page. The first-run Wizard will welcome you.
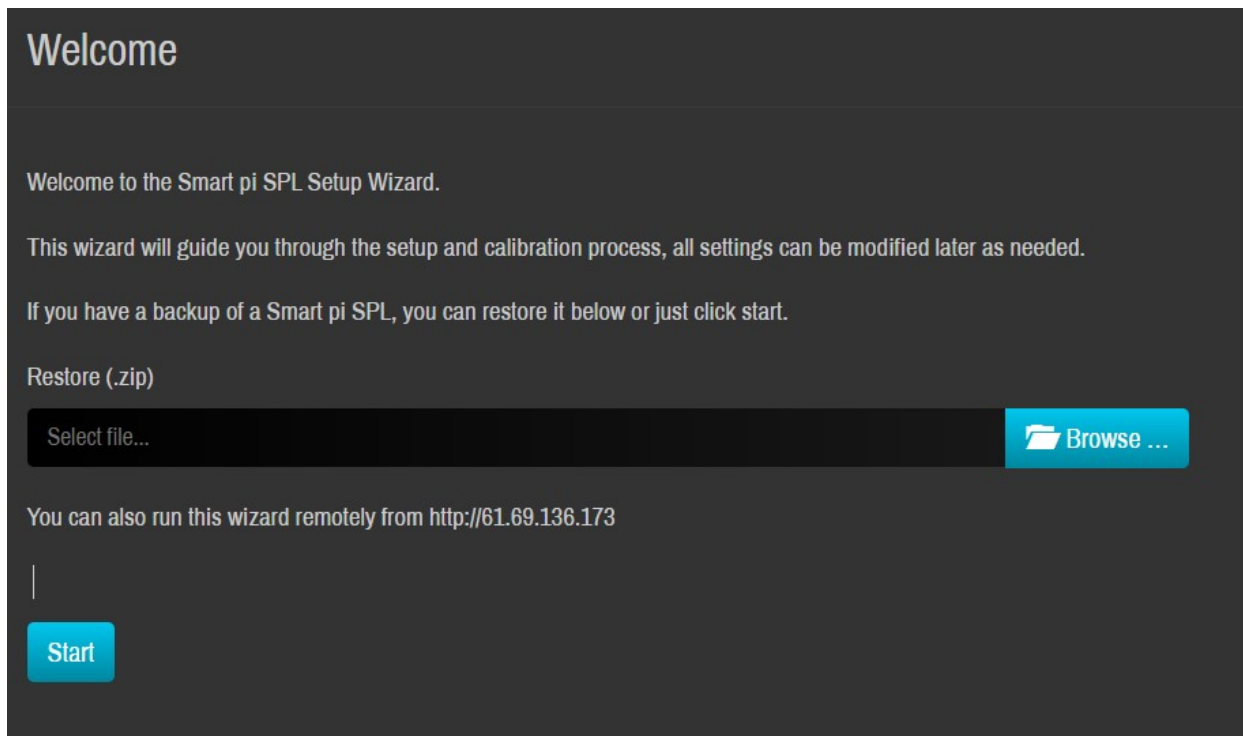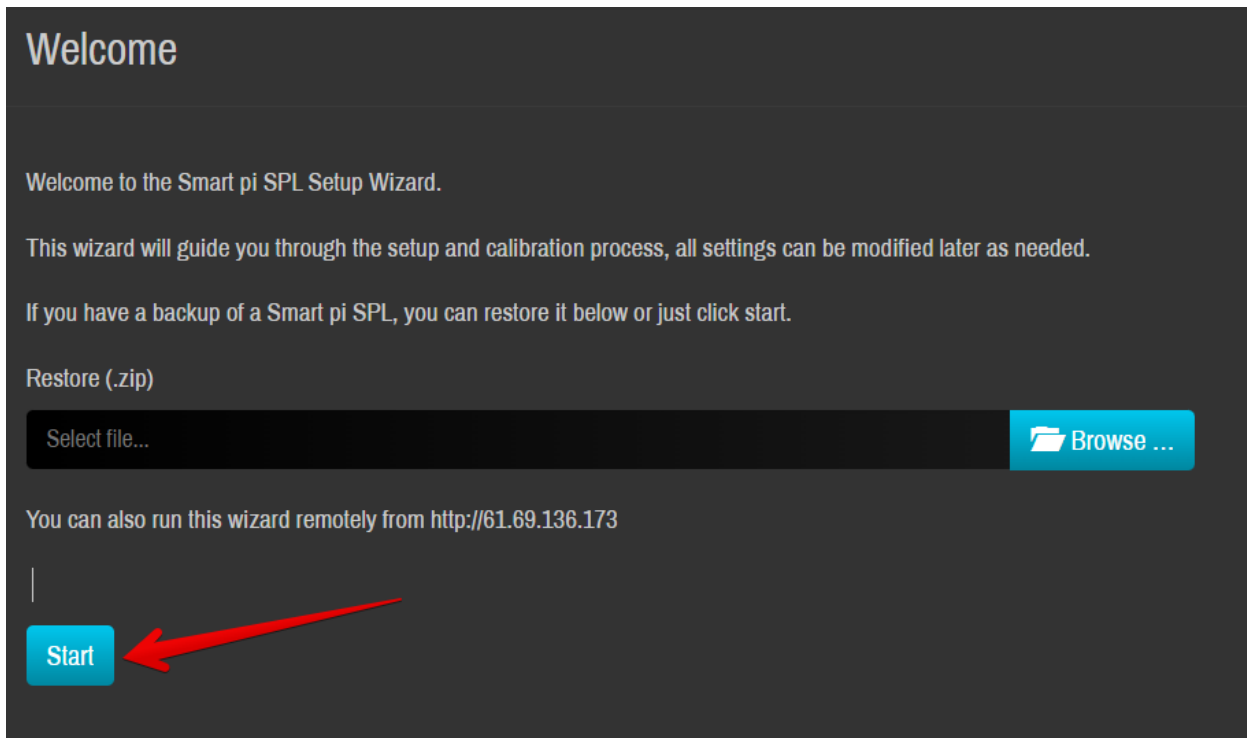
If you have a backup file from a previous server configuration, it can be loaded at this point. Click the **Browse button** to locate and select it on your computer. Then click **Upload**.
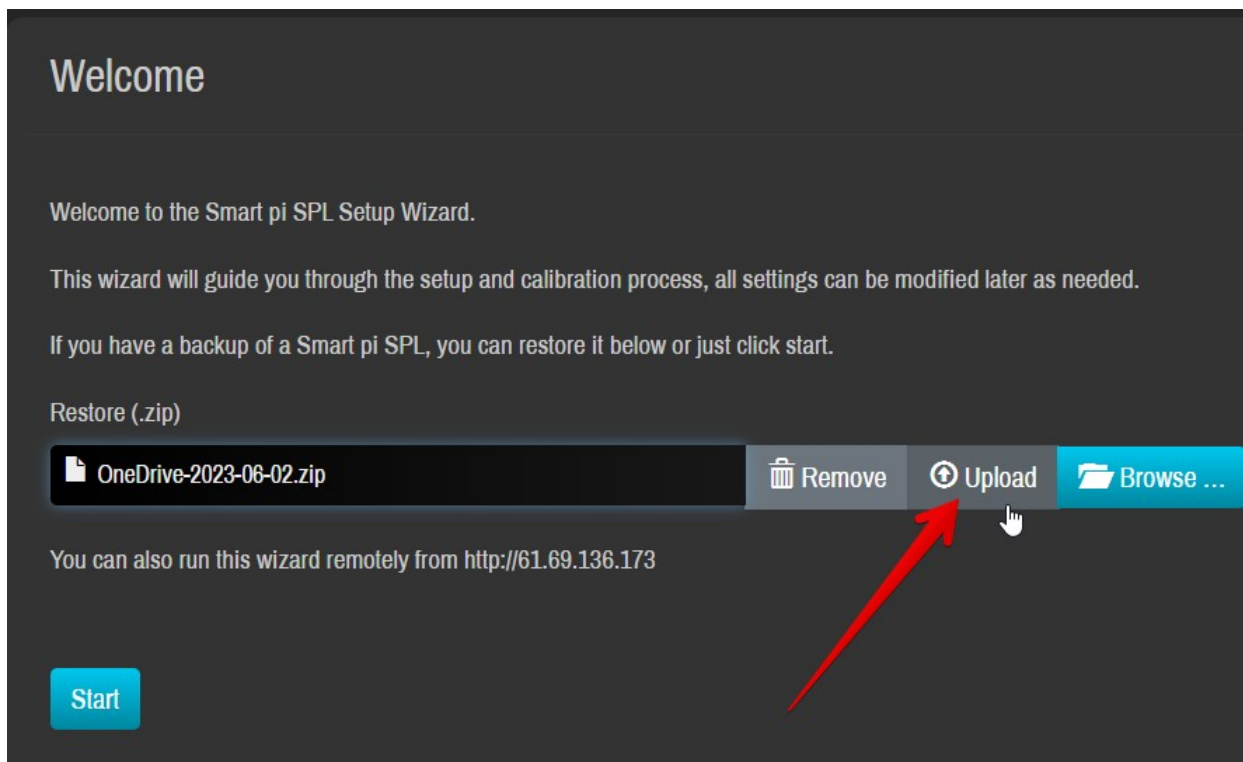
The restoration process could take several minutes if there is a large amount of logging data contained in the backup file. Once the upload is complete, the system will reboot.
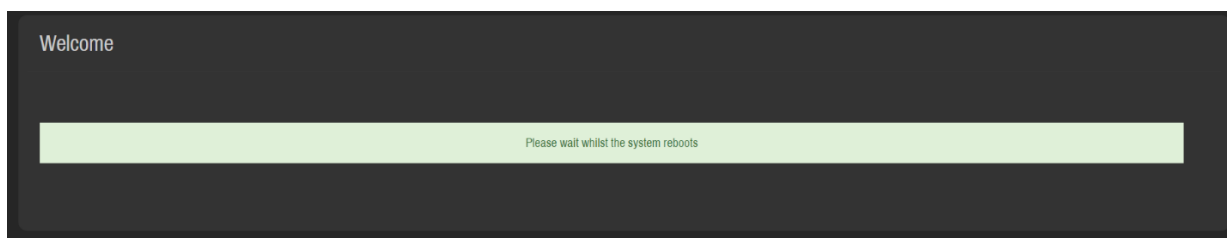
To begin a fresh configuration click **Start**.
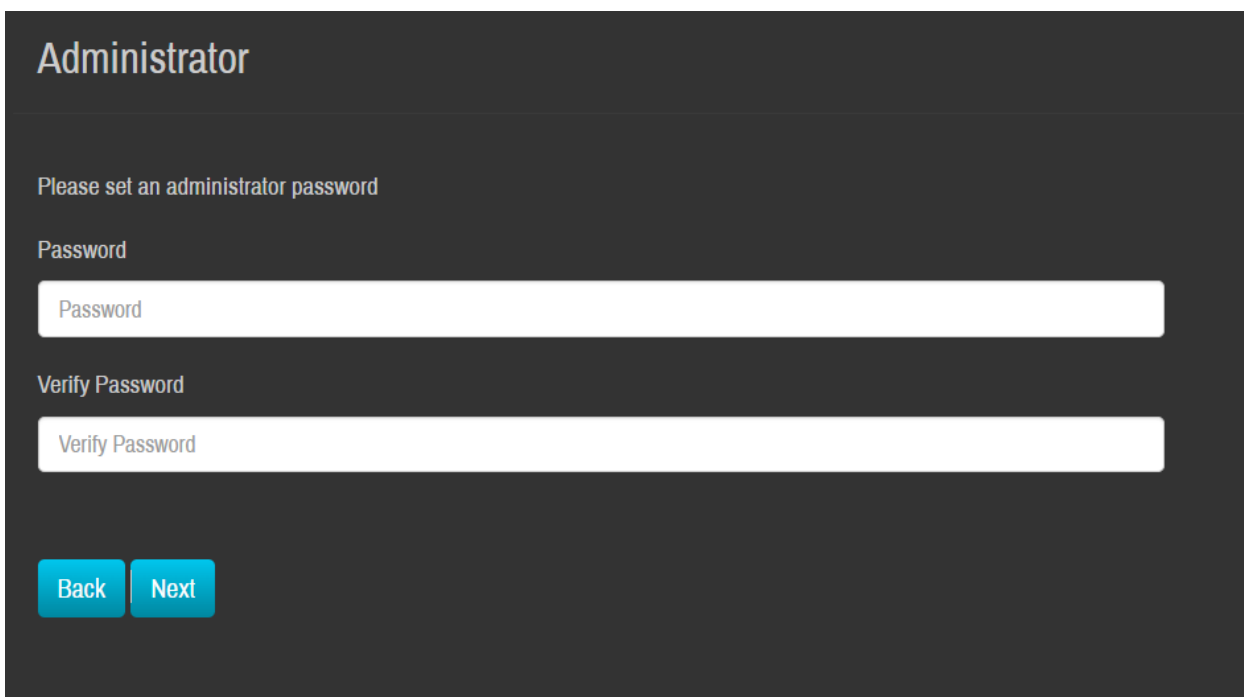
Next, an Administrator password must be set.
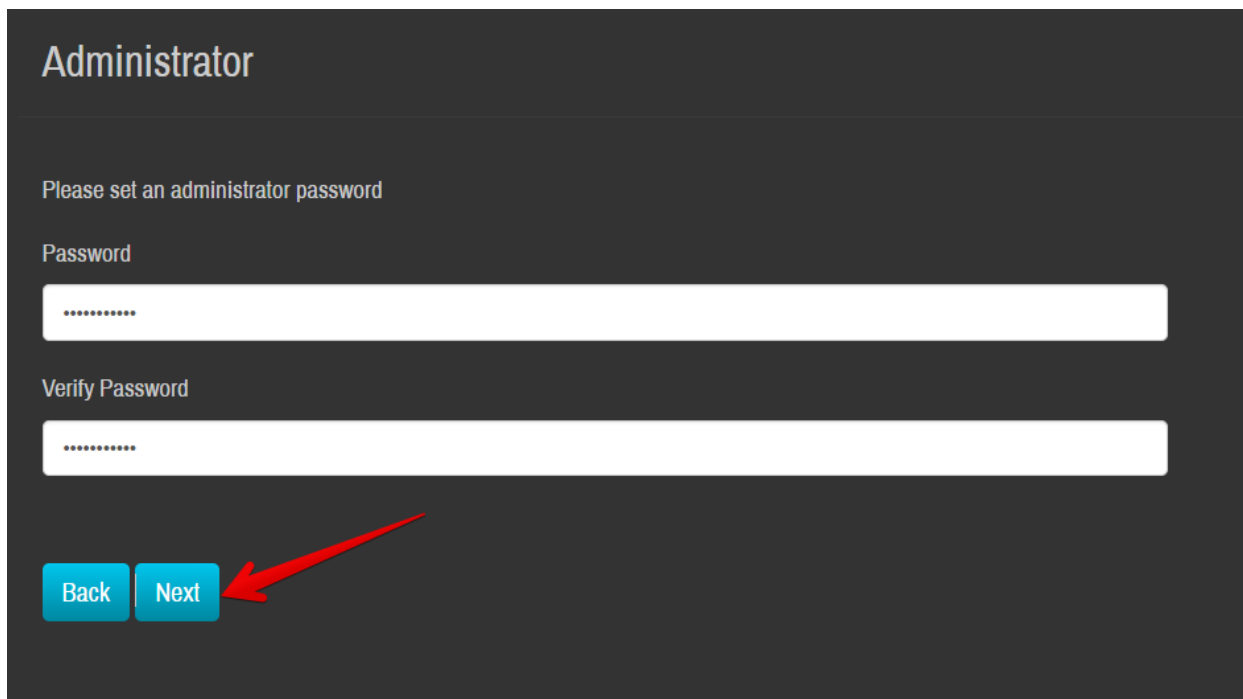
Type a strong password and verify it. Then click **Next** to continue the Wizard.
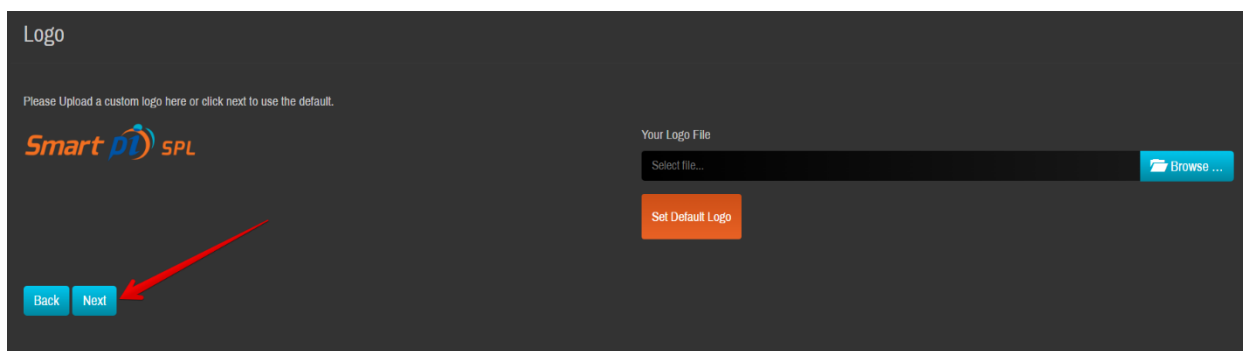
The next screen invites you to optionally upload a logo for your organisation. To skip, just click **Next**, otherwise click the **Browse** button to select a logo from your computer, then click **Upload**. Then click **Next** to continue.
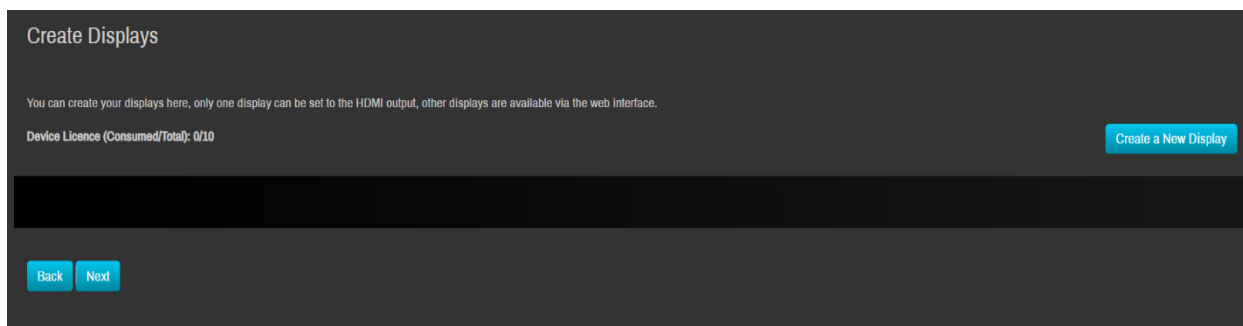
Next, you must create a Display.

Different Displays can show different combinations of SPL metering on the HDMI output. Think of these as pick-and-mix presets of SPL measurements for showing onscreen.

Displays and their configuration are outlined in depth in section 5.3 (Display Settings)

Once you've created a Display, click **Next** to continue.
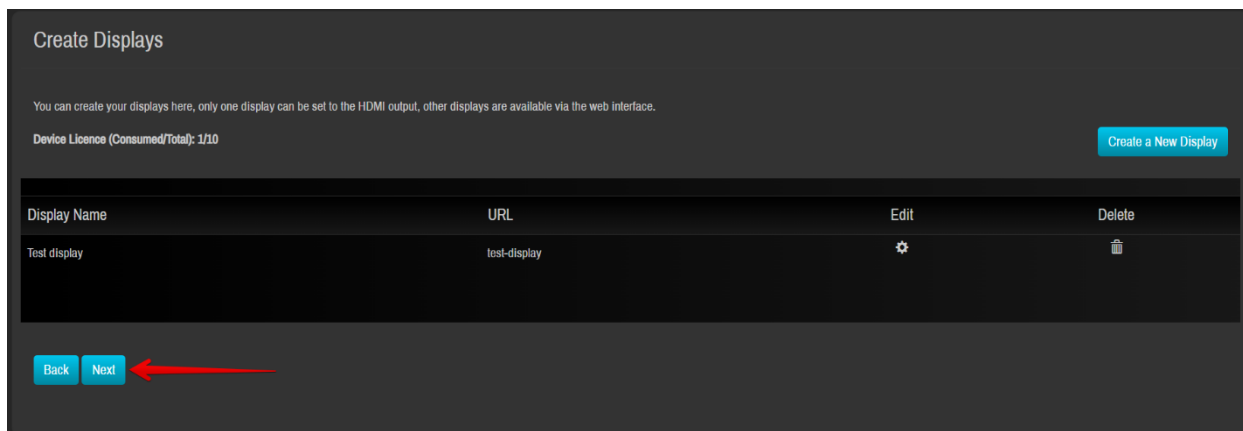
If only 1 Display was created in the previous steps, that will be sent to the HDMI output by default.
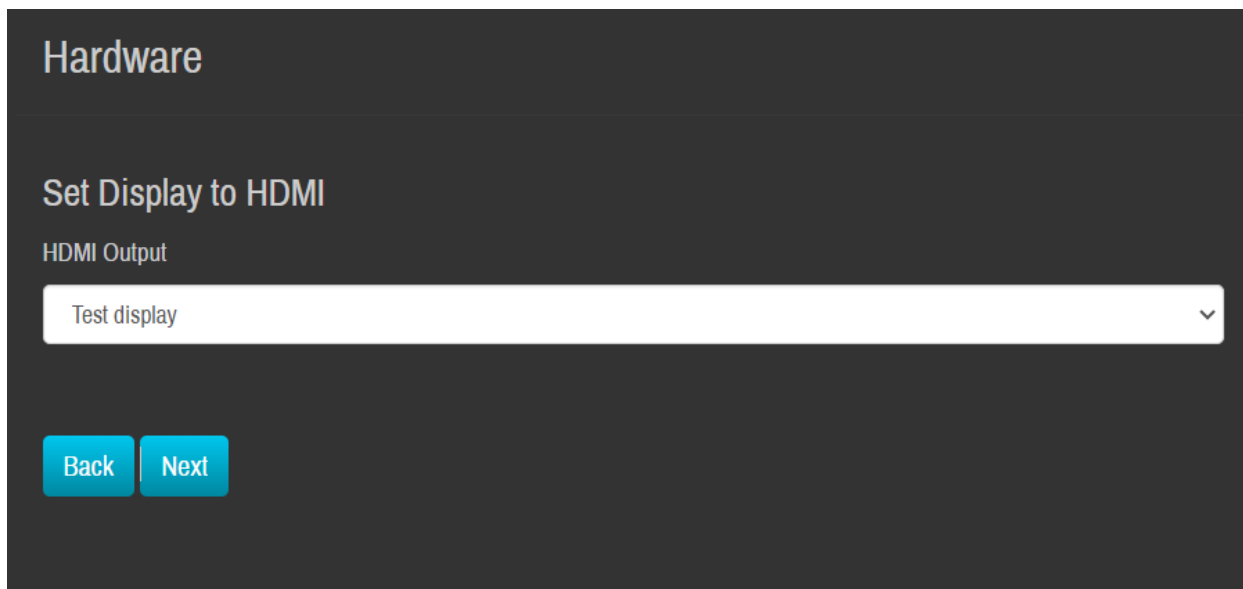
However, if more were created, you can now choose which one to send from the HDMI Output dropdown menu.
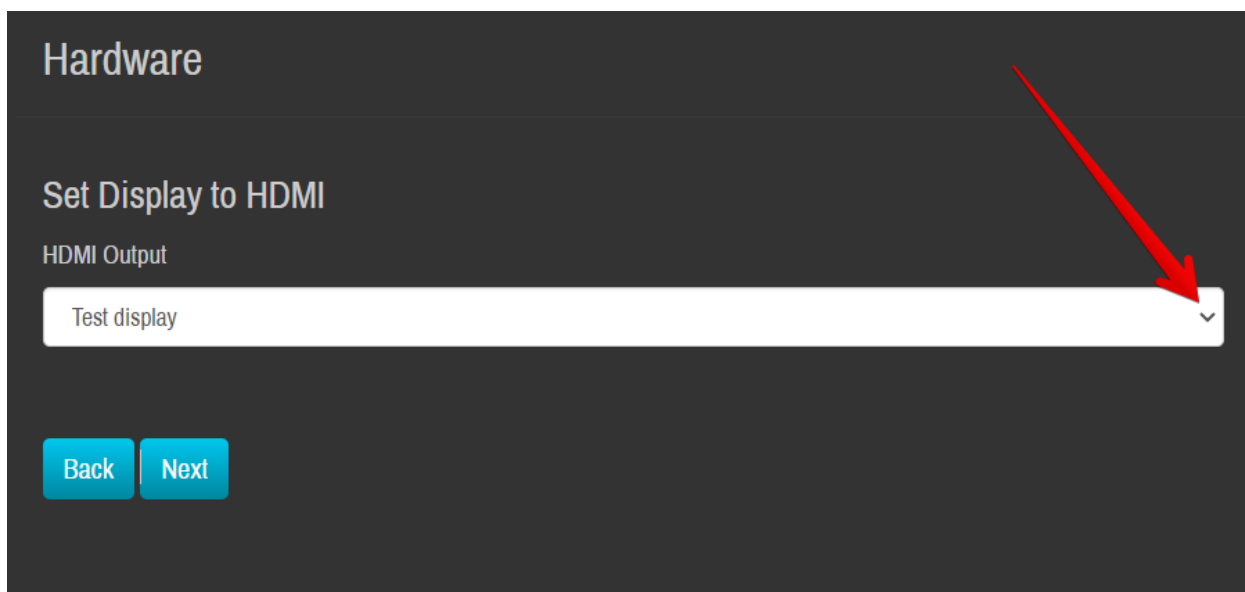
Click **Next** to save changes.
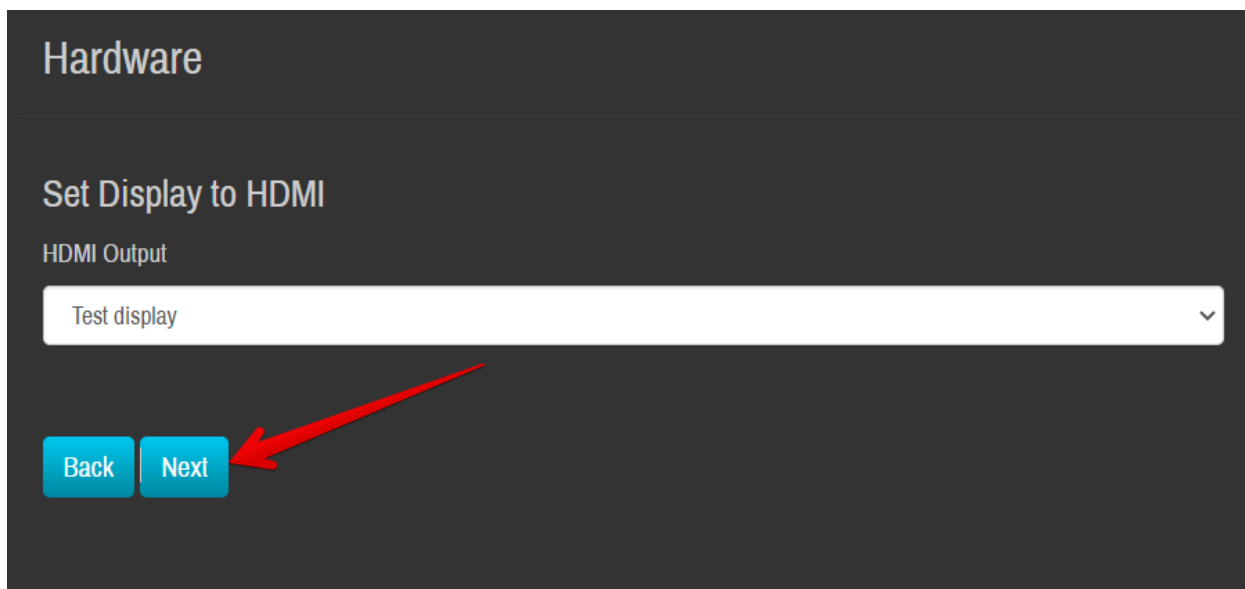
You'll be brought to the Calibration screen. This is where you get to calibrate your microphone via the built-in Wizard.
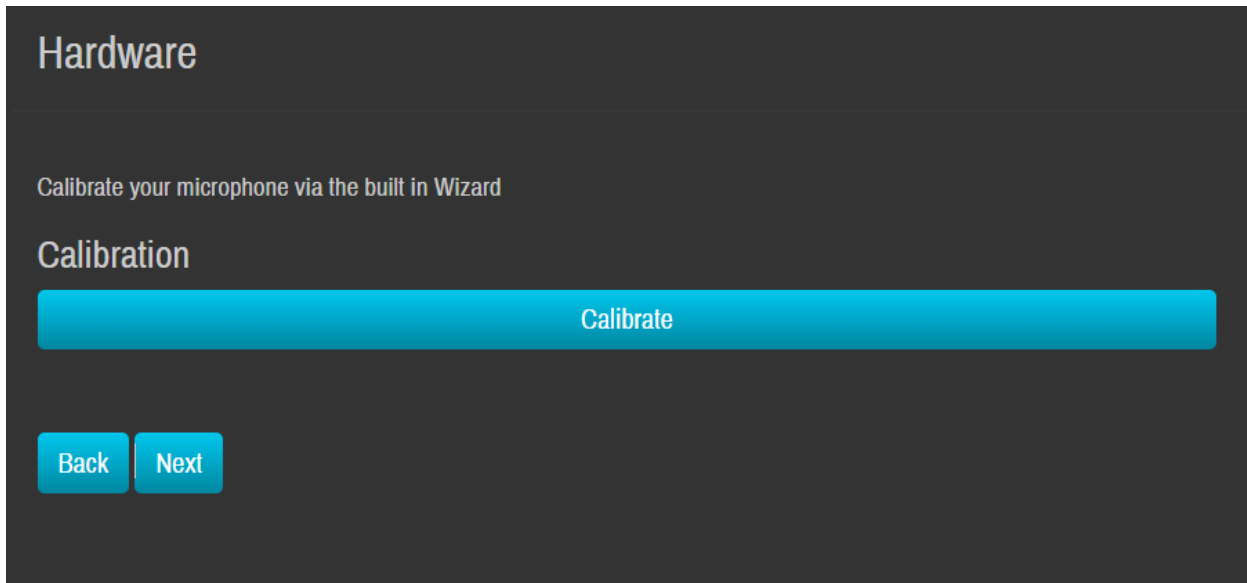
It is essential that microphone input(s)calibration be conducted before the unit is commissioned. This can be done now, or later when the first-run Wizard completes.

See section 6 (Calibration) for instructions on configuring the calibration procedure.
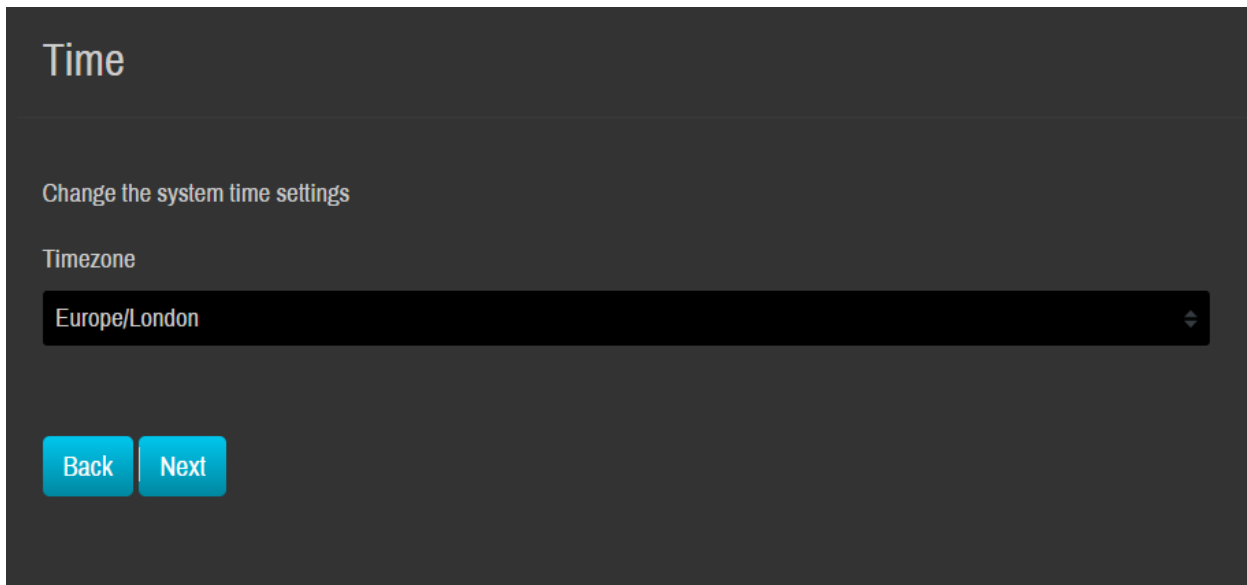
Next, you'll be brought to the network configuration screen.

If required, Network settings can be changed next. Smart pi SPL will have already acquired a wired ethernet network address, however you may wish to change to a wireless connection or change another network variable.

See section 5.5 (Network) for full network configuration.
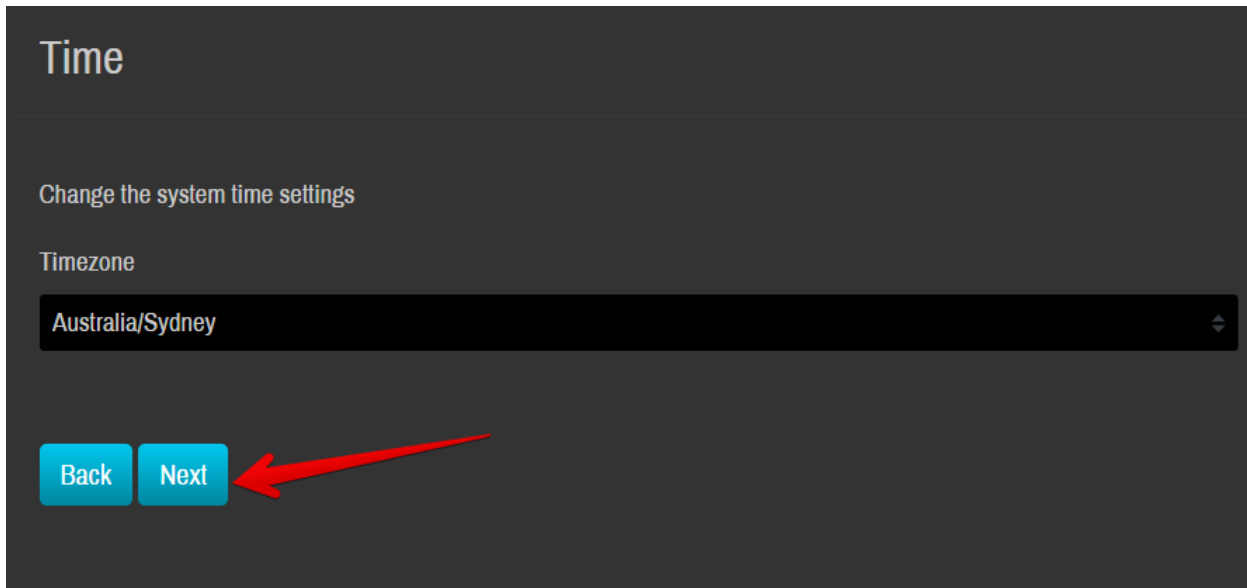
Click **Next** to continue. The default Timezone is Europe (London).
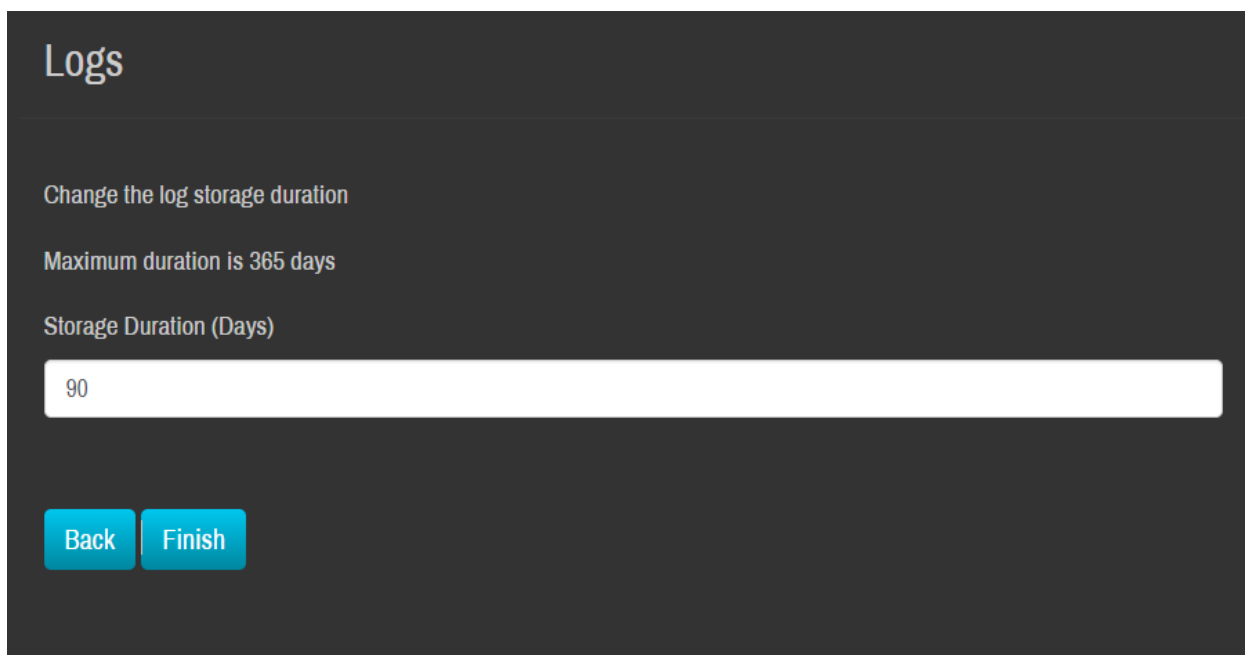
This can be changed from the dropdown menu, and the format must be 'Country/City' for the internet time server (pool.ntp.org) to adjust accordingly.

Click **Next** to save changes and continue.
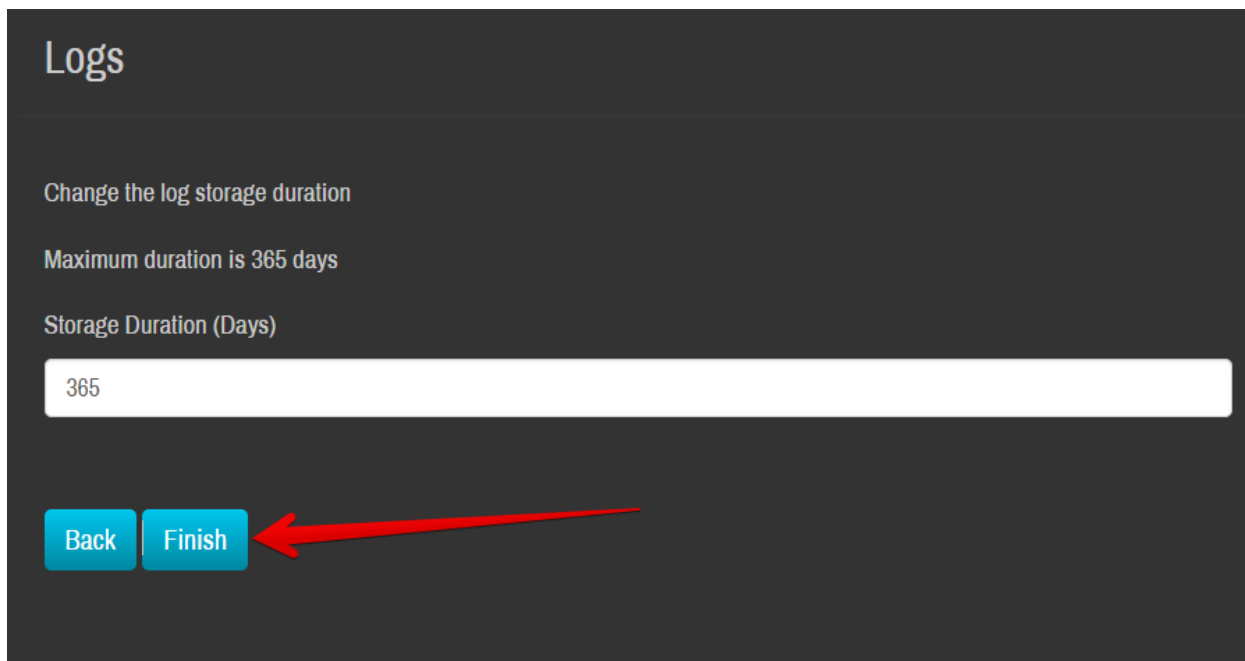
Next up is Logs. The Log keeping period should now be set to a maximum of 365 days (1 year). The default is 90 days.

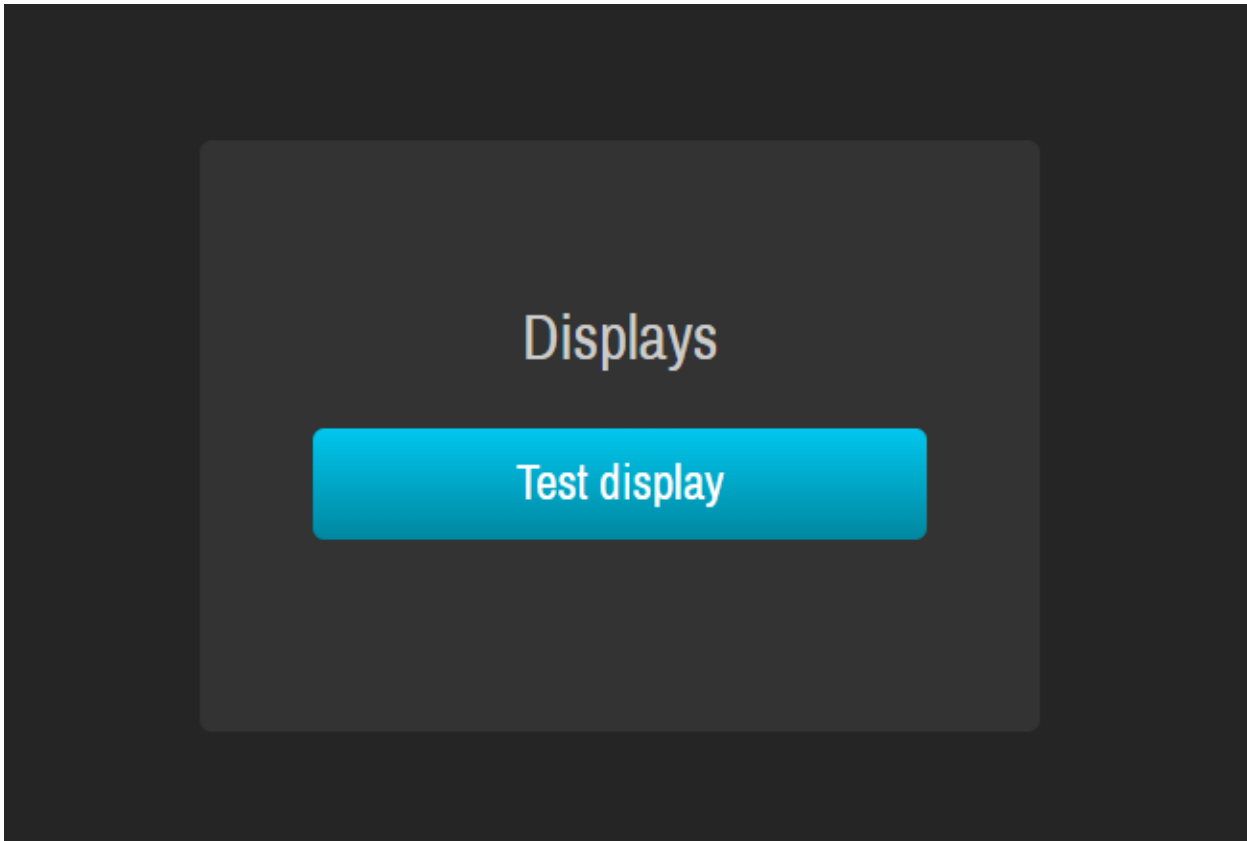Change the storage duration (in days) and click **Finish** to complete the first-run Wizard.

The system will reboot and the next screen will be a list of Displays you've set up. Click on the presented Display to review your work. We set up a Display called "Test display" so we'll click on that instead.

Below are the results of our test display:
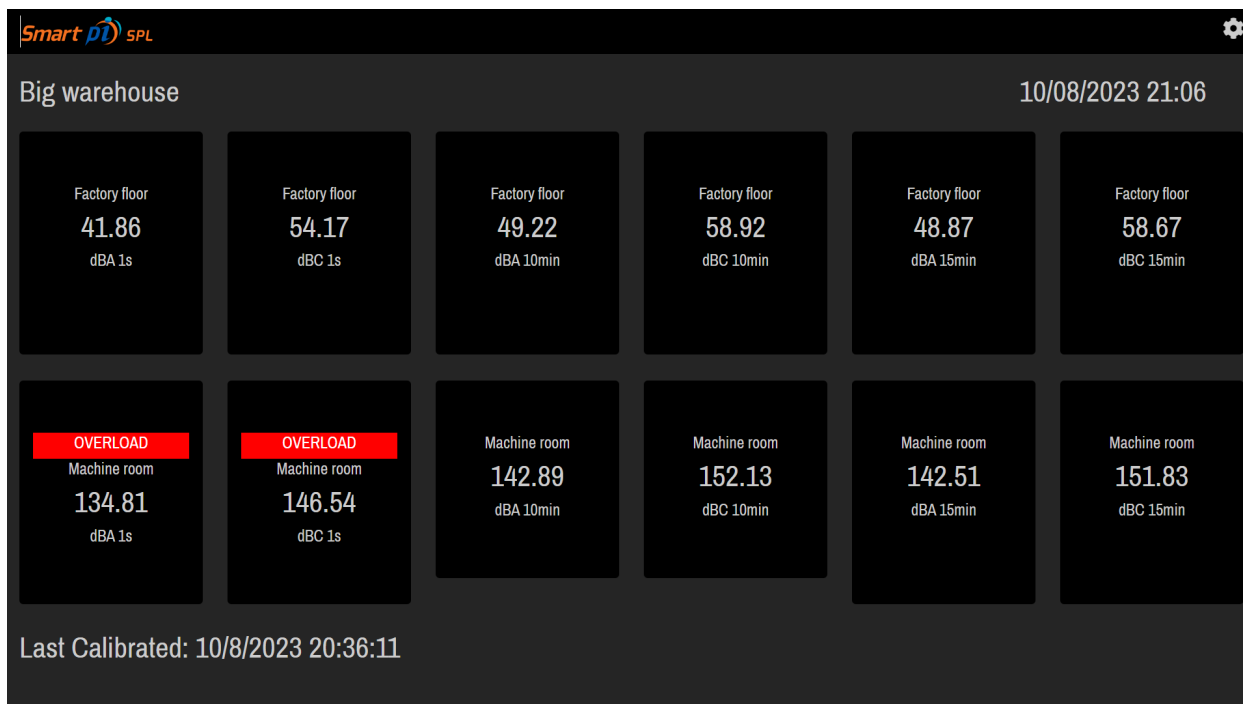
Here is an example of a Display featuring the use of 6 SPL measurements in two locations in an imaginary venue called 'Big warehouse'. Each SPL measurement permutation is displayed in real-time, and it appears that things are louder on the 'Machine room' than they are in the 'Factory floor'!

5. GENERAL OPERATION

All Smart pi SPL settings and management functions are facilitated via a web browser. Your network administrator will supply the address to point your browser to.

Smart pi SPL features a responsive web interface. It will detect whether it is being accessed by a desktop or mobile device, and configure the display to suit.
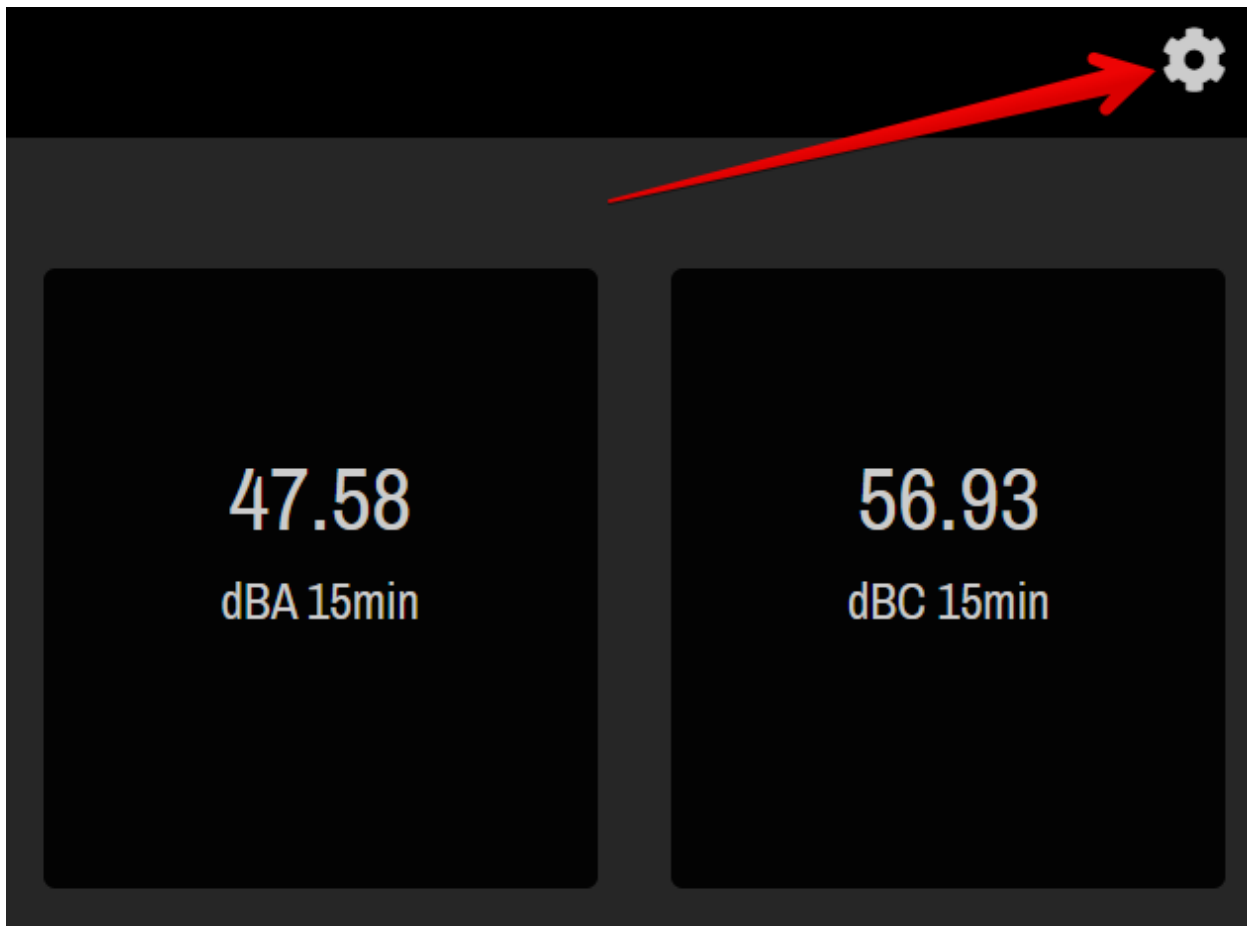
The General Operation instructions assume that the unit has previously been setup and configured, and provides a guide to reviewing and changing configuration settings.
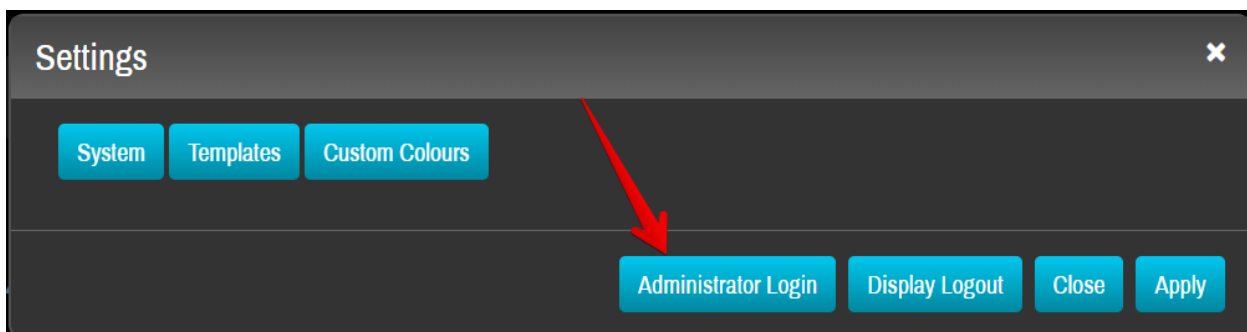
5.1 Logging in - Administrator

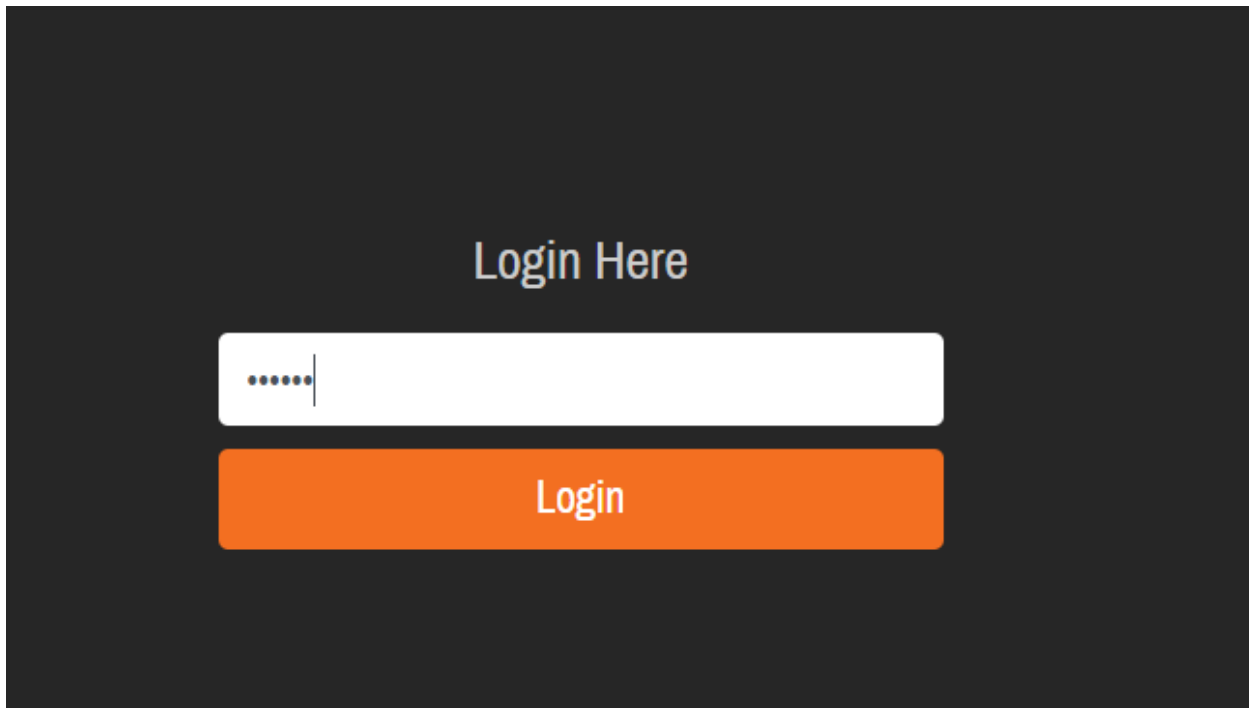In your web browser, enter the network address for a configured Smart pi SPL. Click on a Display.
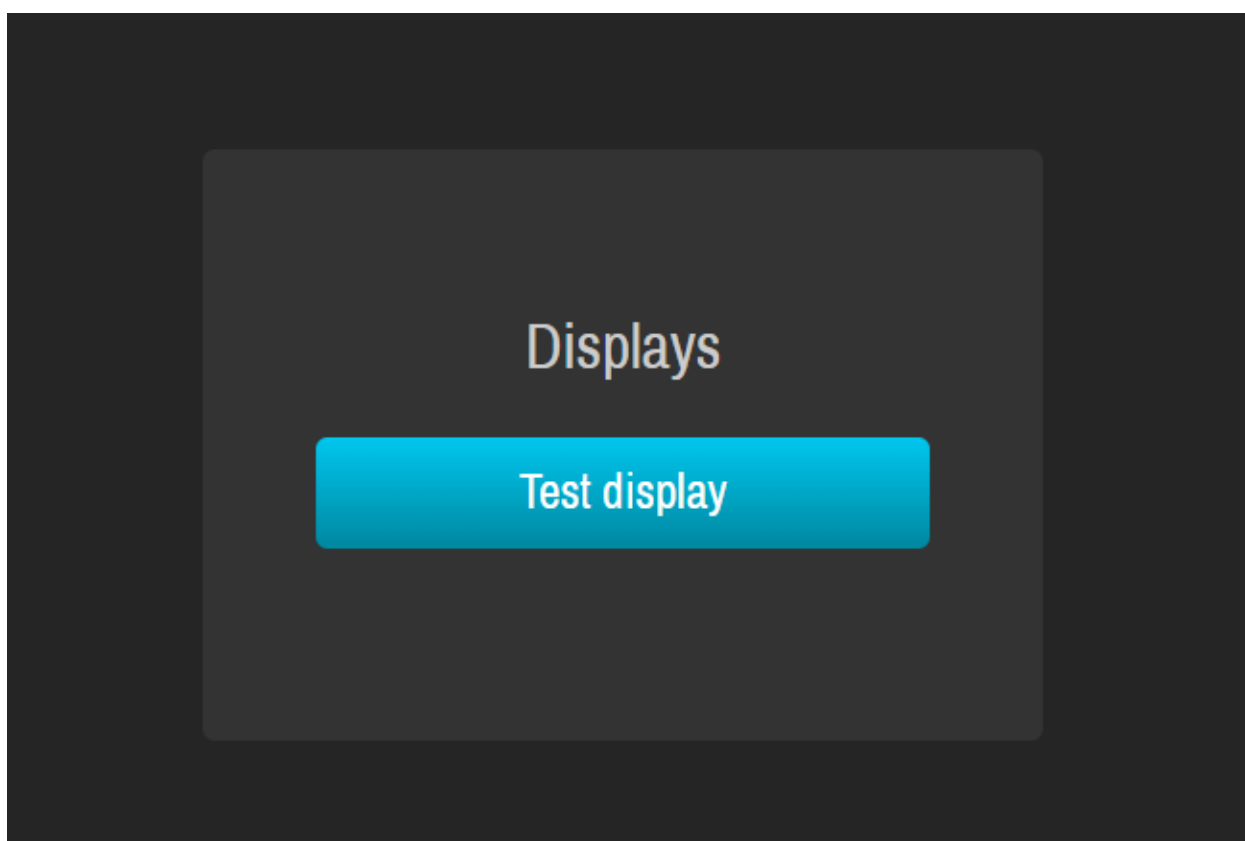
Then click the settings icon.
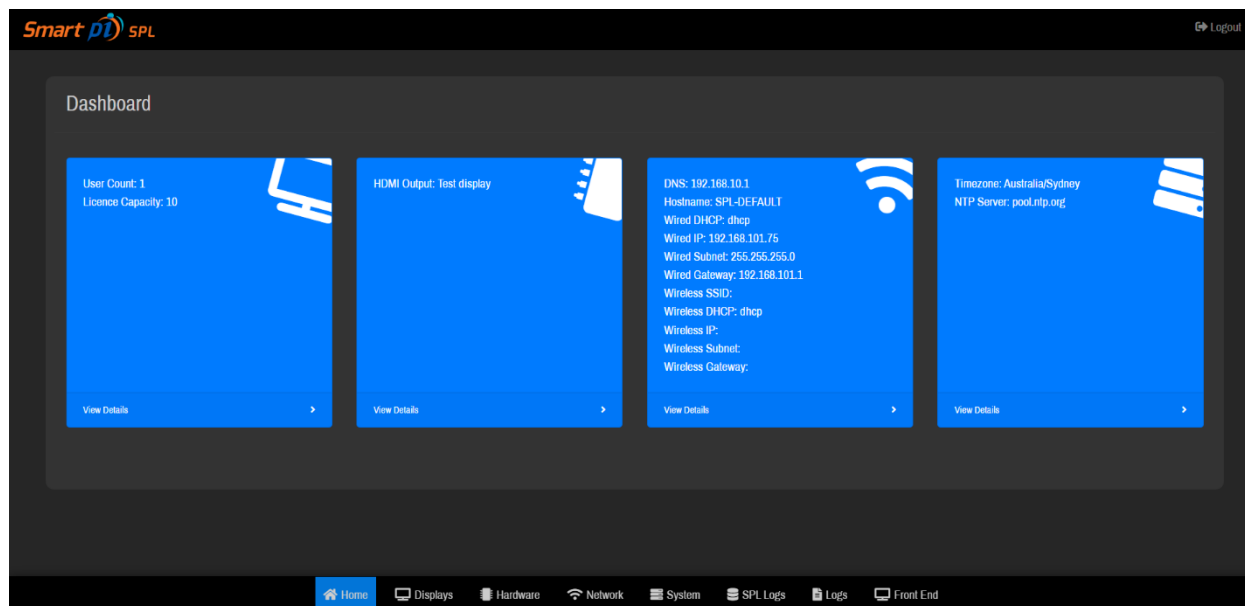

Click **Administrator Login**.

Click **Yes** when prompted and enter the Administrator *password* and click **Login** to enter Smart pi SPL.

5.2 Dashboard

After a successful login to the first page see the SPL Meter Administration Dashboard.

The Dashboard gives a quick overview of common settings. In the above example, there are four quick view items shown.
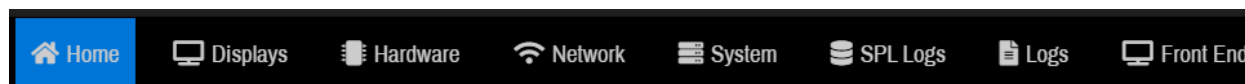
There is a **User** count (how many users are allowed) and **License** count (how many Displays allowed.

There is the selected **Display** being sent to the HDMI output.

There are **Network** connectivity details.

Details about the **Timezone** and time protocol server settings.

All possible system configuration functions are available from the Dashboard's menu at the bottom.

5.3 Displays settings

Clicking **Displays** in the Dashboard bottom menu opens the Displays Table.

A table of Displays created by users of the system will be presented. Initially this table will contain entrees that were setup during the first-run Wizard (or it may be empty if no Displays were set up).

A Display is defined as the SPL viewing configuration that will be sent via HDMI to the monitor. Displays are highly configurable and can feature up to 12 real-time SPL measurements each (6 per Input), plus a statement about the last calibration date of the device.

The example above features one Display: Queen Victoria Building Sydney and Western Sydney International Airport. Each Display has a Link URL (for viewing), a Last Edited date reference, and buttons to Edit or Delete the Display.

To create a new Display, click the **+ Add display** button in the top left of the Displays Table.
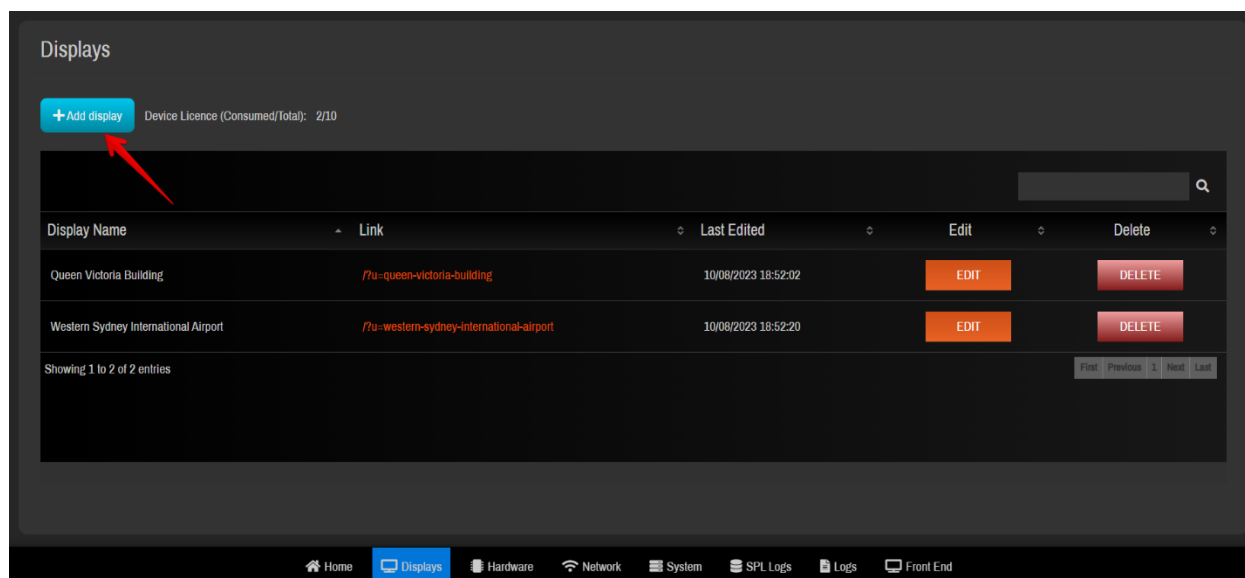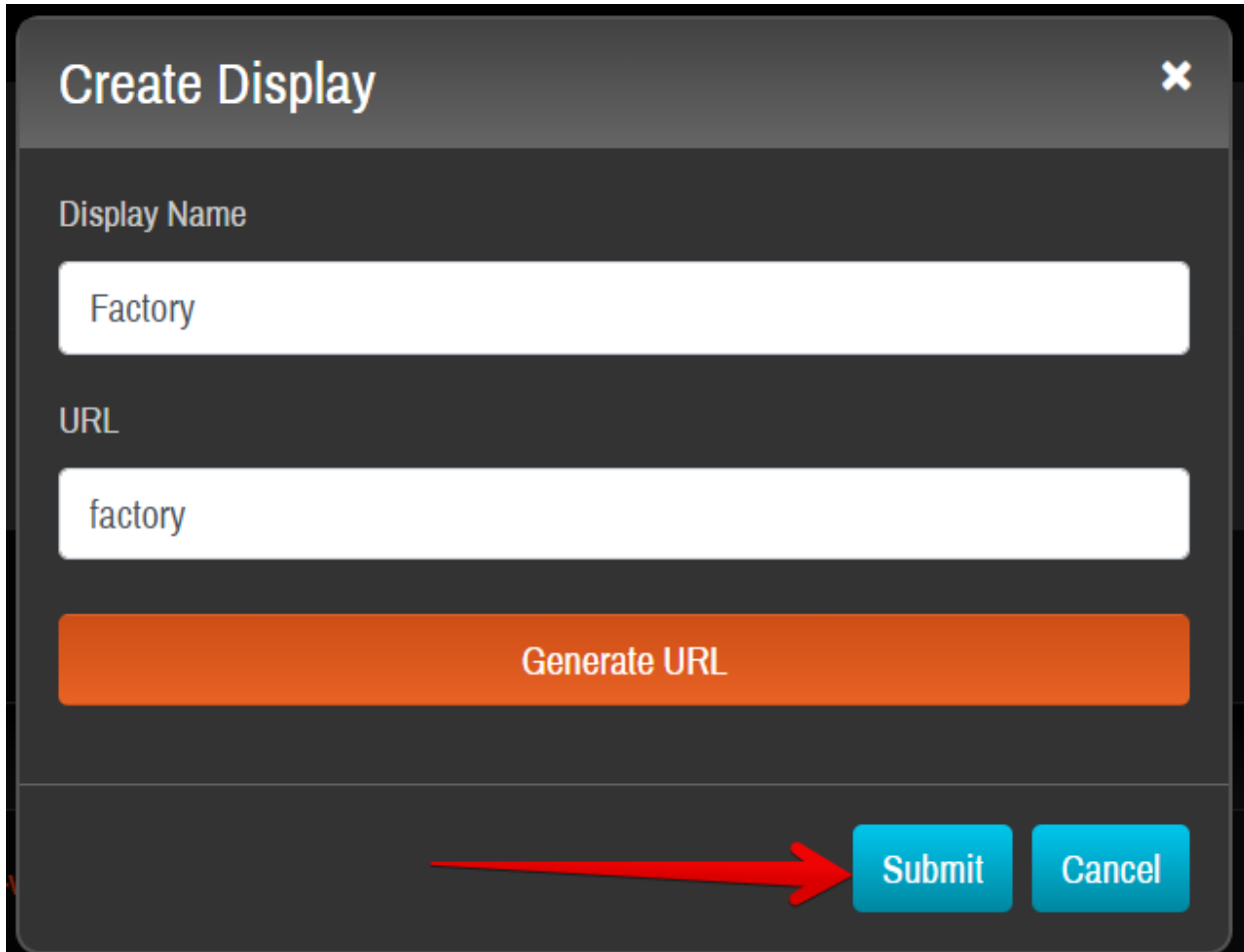

The Create Display dialog will open. Type in a name for the new Display in the **Display Name** text box. Then, click **Generate URL** to have Smart pi SPL automatically create an address where the Display can be viewed in a browser, or alternatively manually type in your own.

In the above example, the new Display has been named 'Factory', and Smart pi SPL has generated the URL of 'factory'.

Click **Submit** to save the new Display.

You'll get a success message, and the new Display will now be listed in the Displays Table.

The new Display 'Factory' now needs a selection of SPL measurements to show on-screen. In the Link column of the table, click on the URL Link to view the Display output.

Pre-configuration, the Display output will be sparse - only the Last Edited date is shown.

Click on the settings icon to access the Settings dialog for the Display.
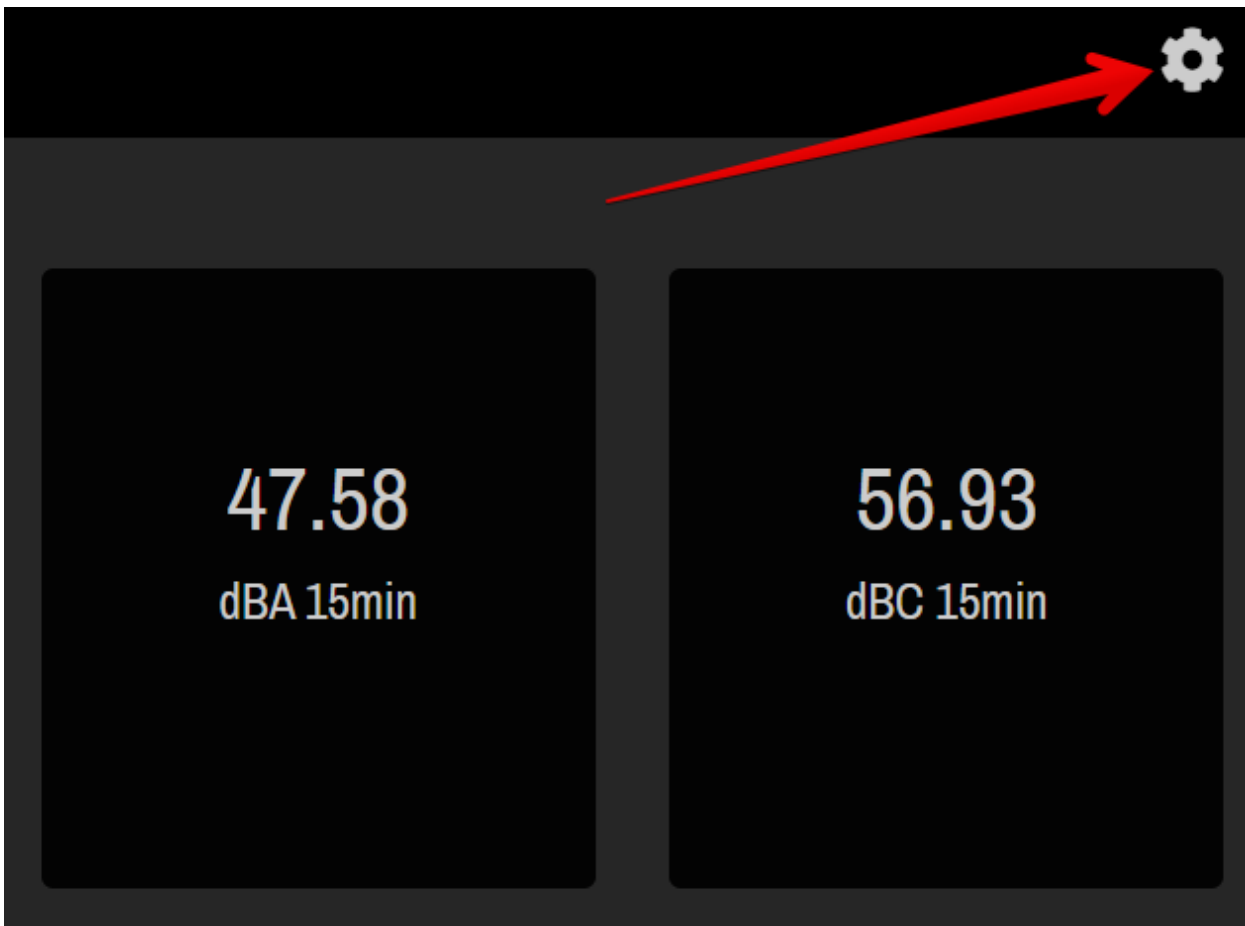
Click **System** to show the SPL selection and naming dialog.
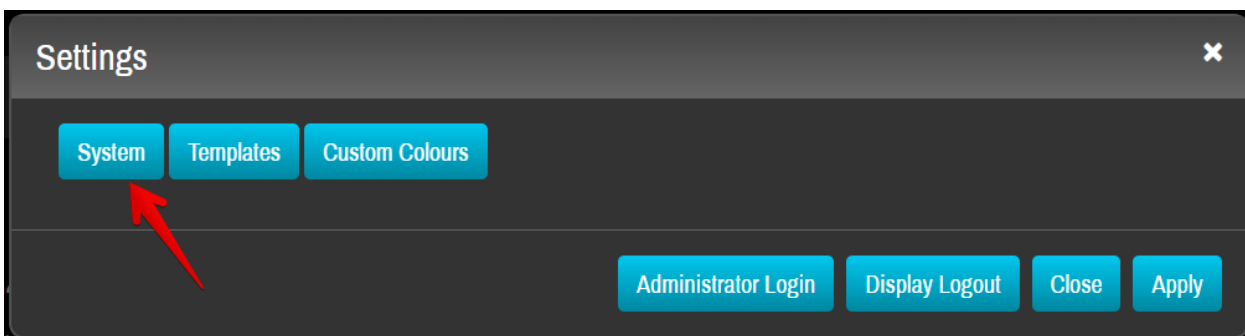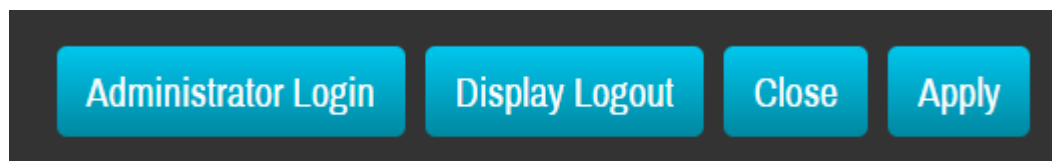
In this example, the SPL sound sampling Location has been given as 'Big Warehouse'. Input 1 and Input 2 have been enabled and are named 'Factory Floor' and Machine Room' respectively. All SPL measurements for both Inputs have been enabled by check boxes, but any combination is possible.
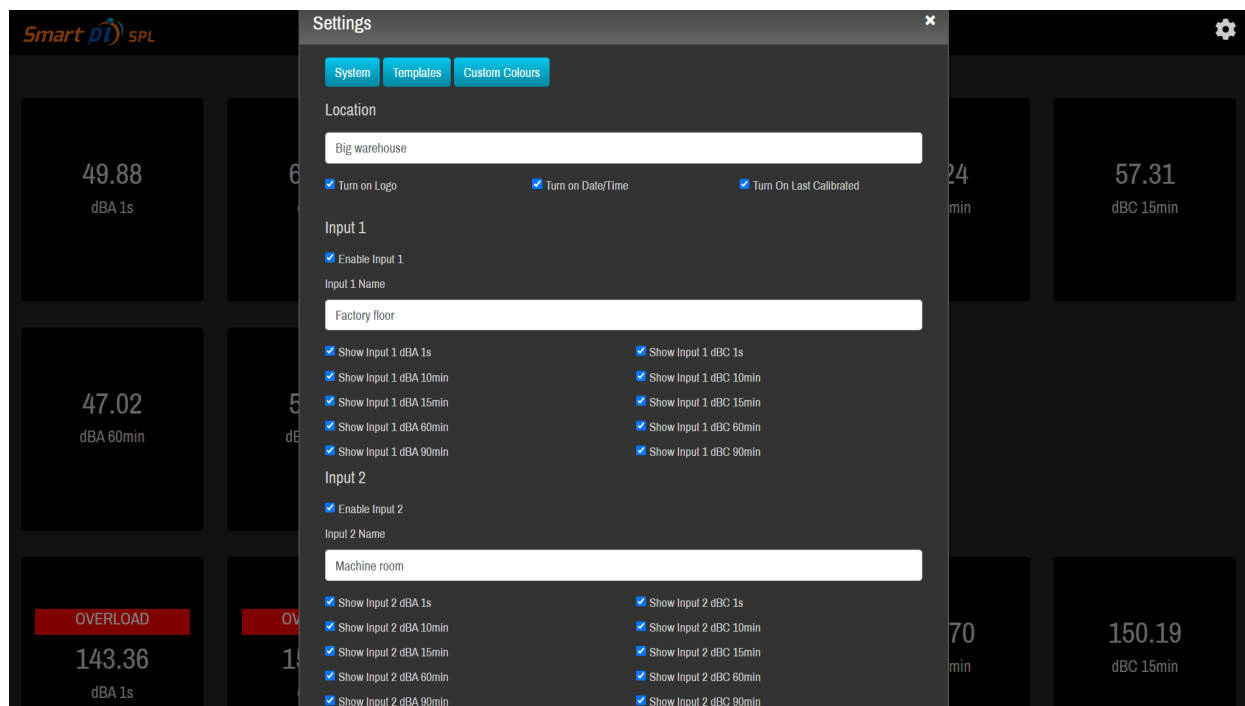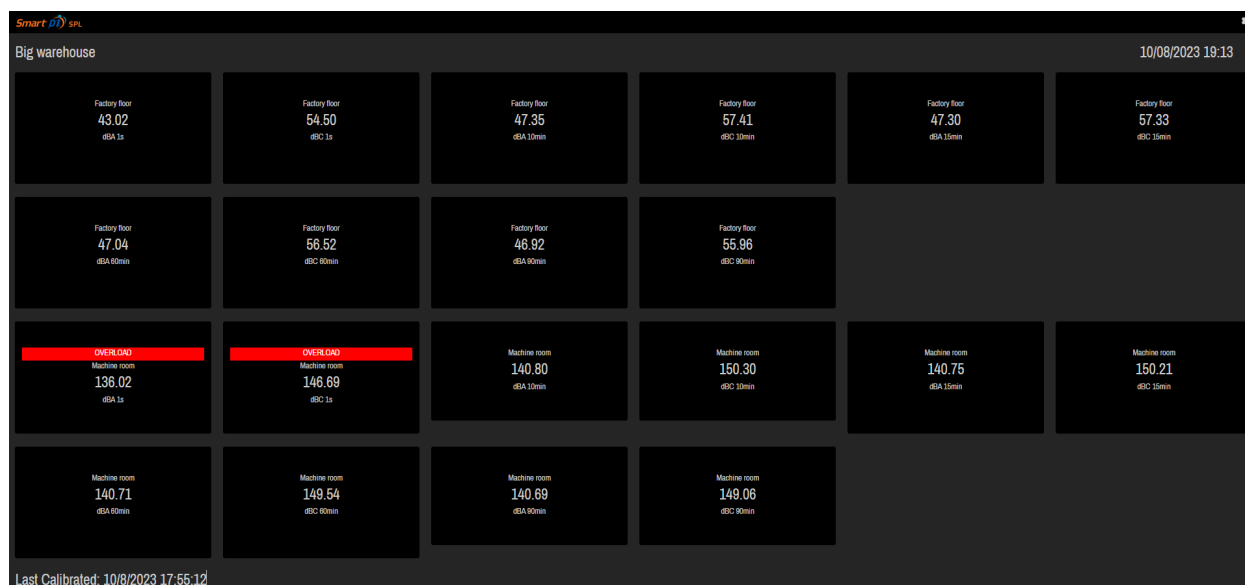

Scroll down a bit and click **Apply** and then **Close** to view the changes.

What you see is what will be displayed on the HDMI output of the Smart pi SPL unit when this Display is selected (see section 5.4 – Hardware Settings)

Here's what the new Display 'Factory' looks like:

All the SPL measurements for each Input are displayed in real time, along with the current date / time, and the occurrence of the Last Calibrated date. Modification of the Display can be made by clicking the Settings icon in the top right and **System** once more.
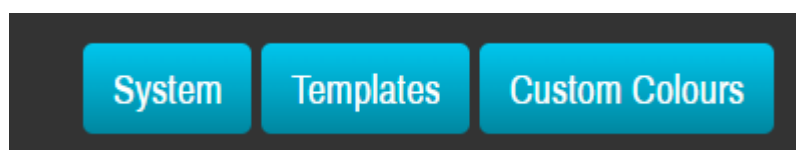

Click Settings (the icon in the top right) and then either **Display Logout** to return to the front page list of Displays, or **Administrator Login** to continue with other configuration.
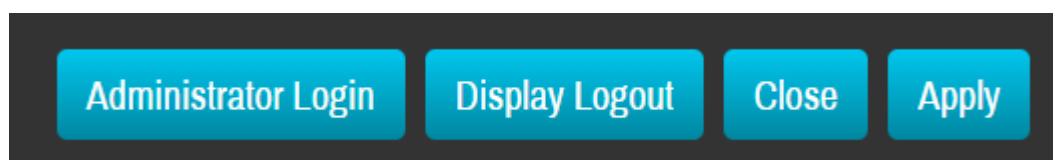

After Administrator Login we will arrive back at the Dashboard. Any display can be modified by clicking its corresponding Edit icon. A Delete icon is also available for unwanted Displays.

5.4 Hardware settings

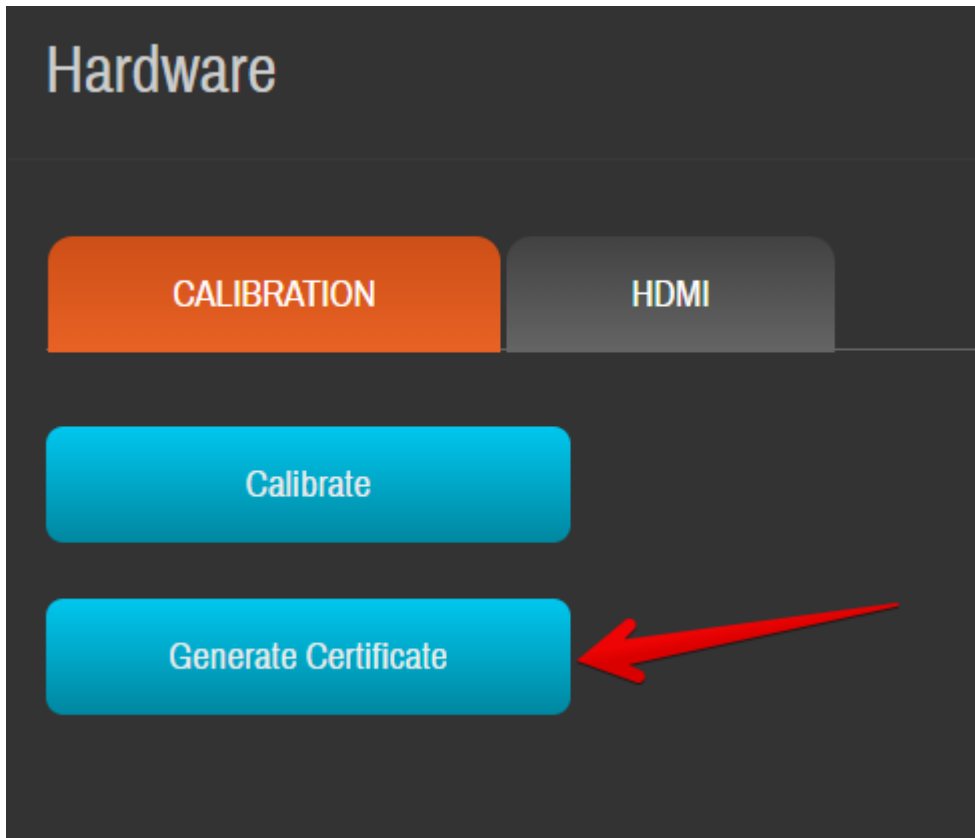From the Dashboard side menu, clicking **Hardware** opens the **Hardware** configuration window.
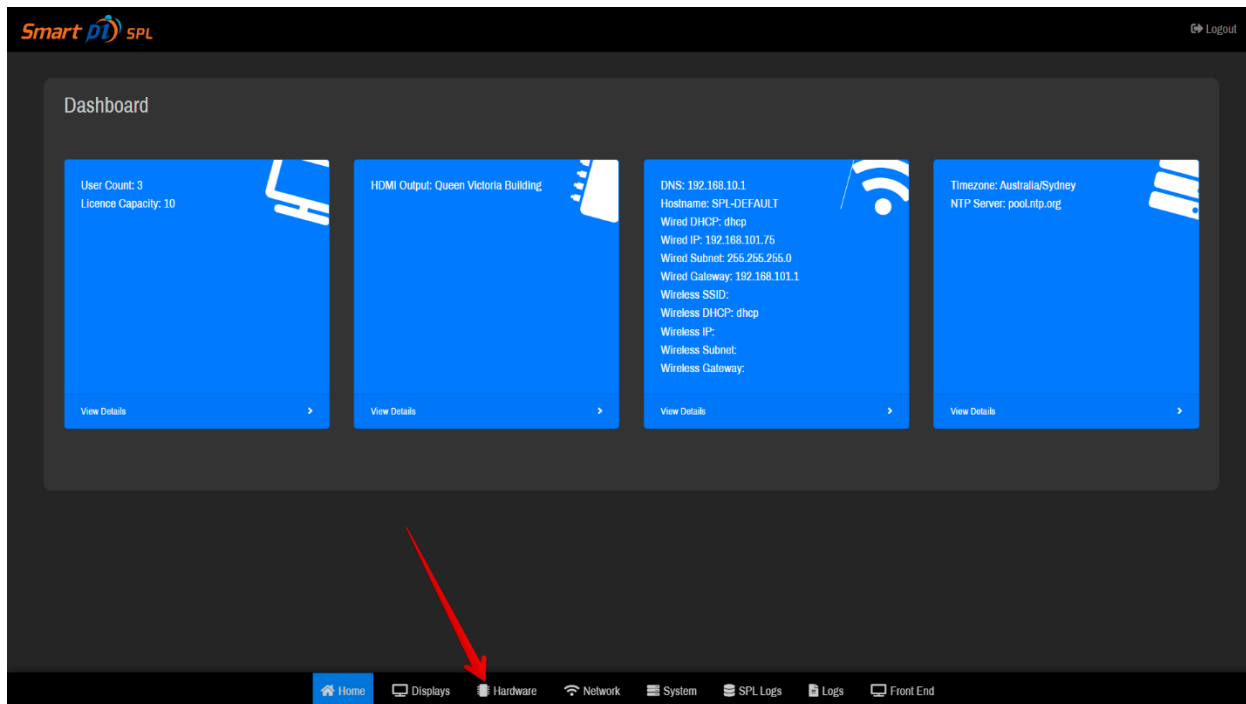
Calibration and HDMI output functions are controlled here. Click **Calibrate** to initiate calibration with the Input microphone(s). [See section 6 (Calibration)](#) for more information.
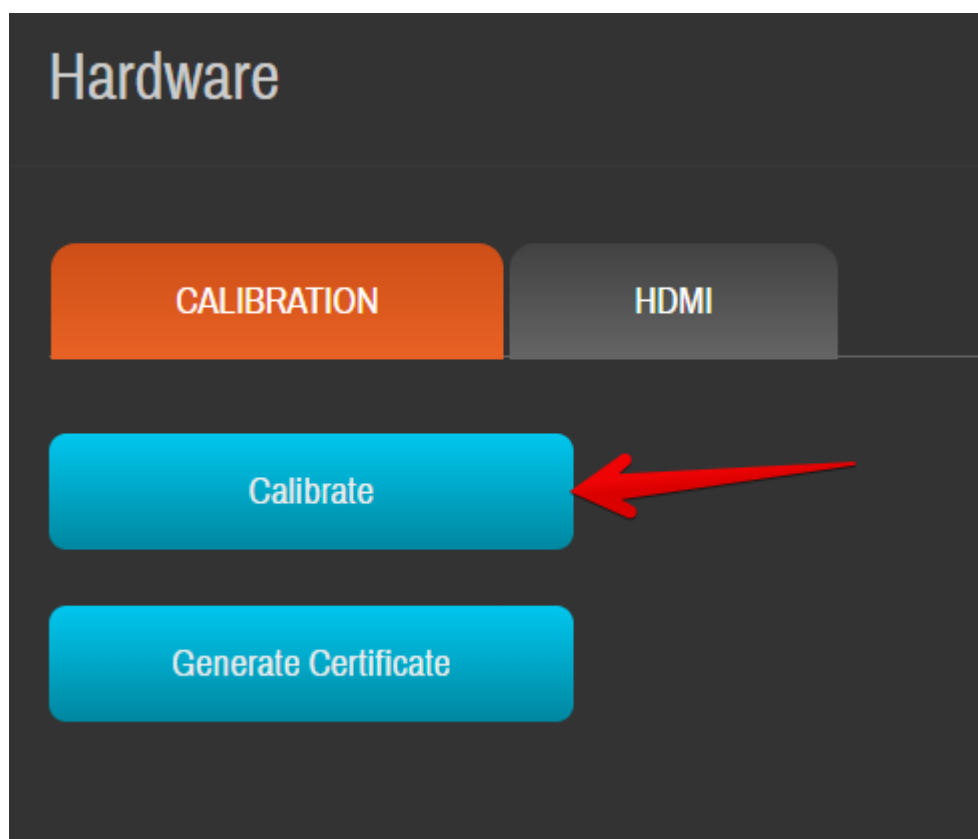
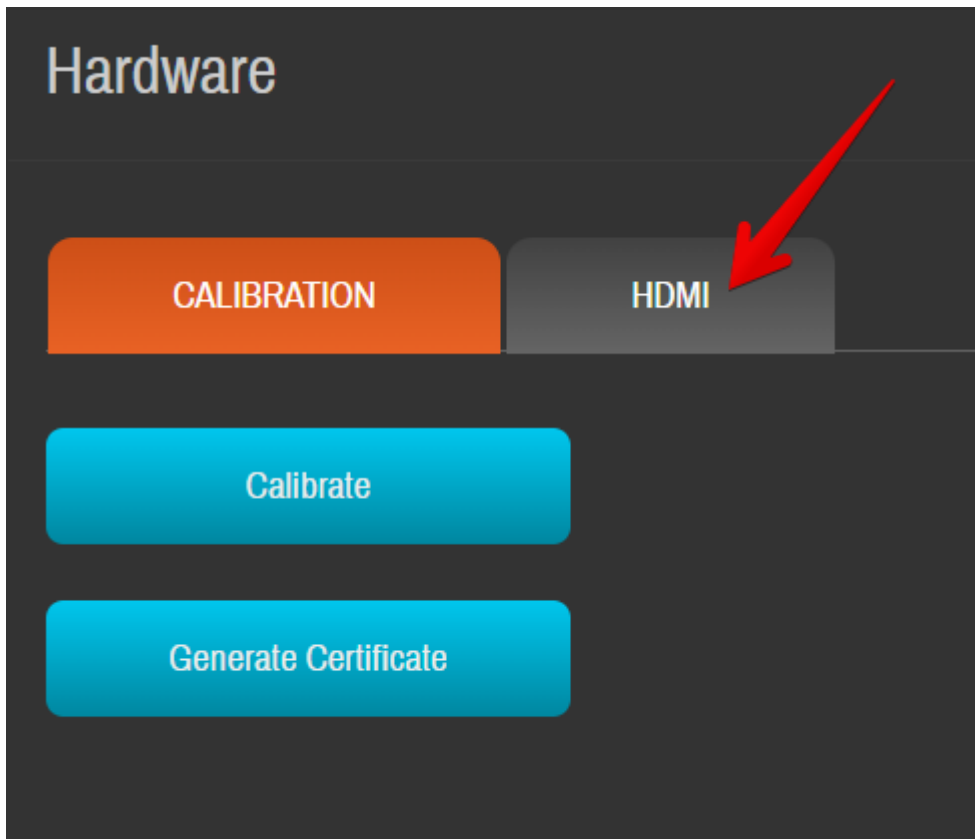> Calibration of Smart pi SPL requires an additional sound calibration device.
>
> Smart pi recommends the BWSA Tech Sound Calibrator CA114/115 (BWSA 2018).
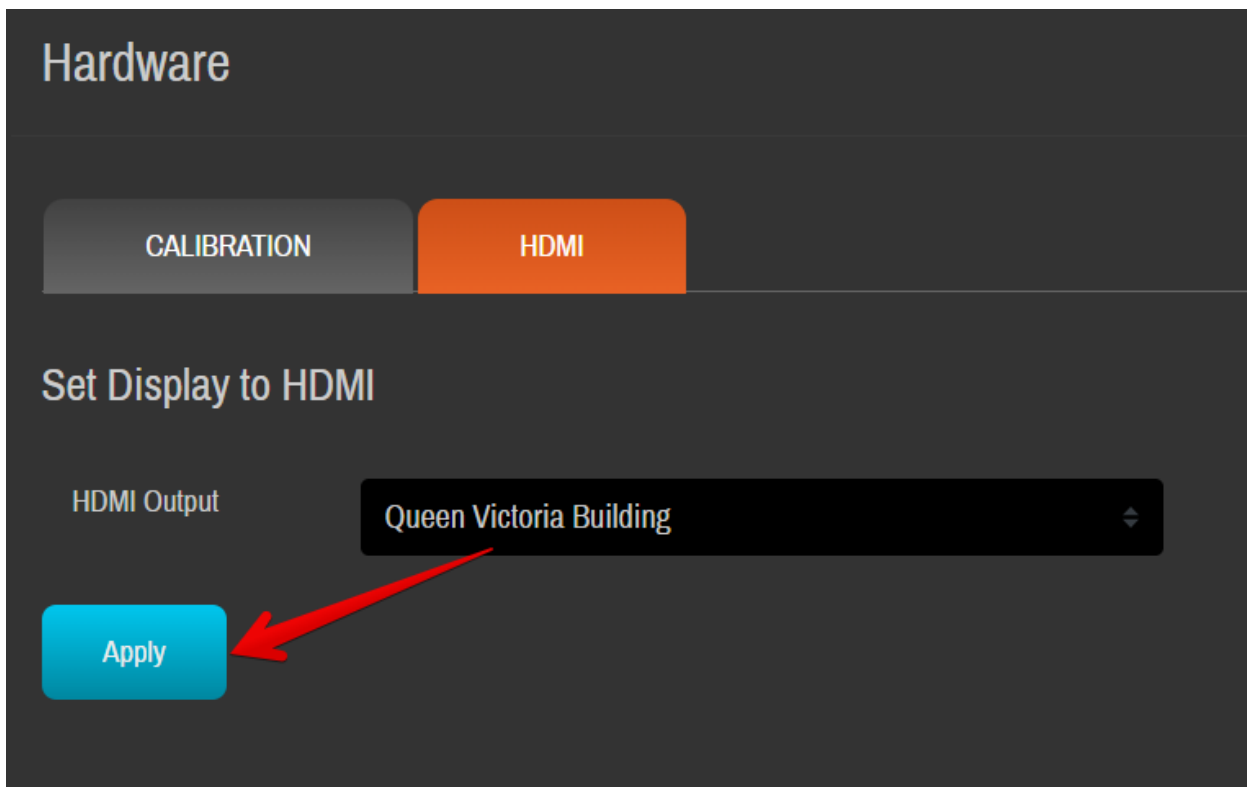
The Generate Certificate button will produce a downloadable certificate with details of themes most recently performed calibration.

Clicking on the **HDMI Output** dropdown box will list all Displays.
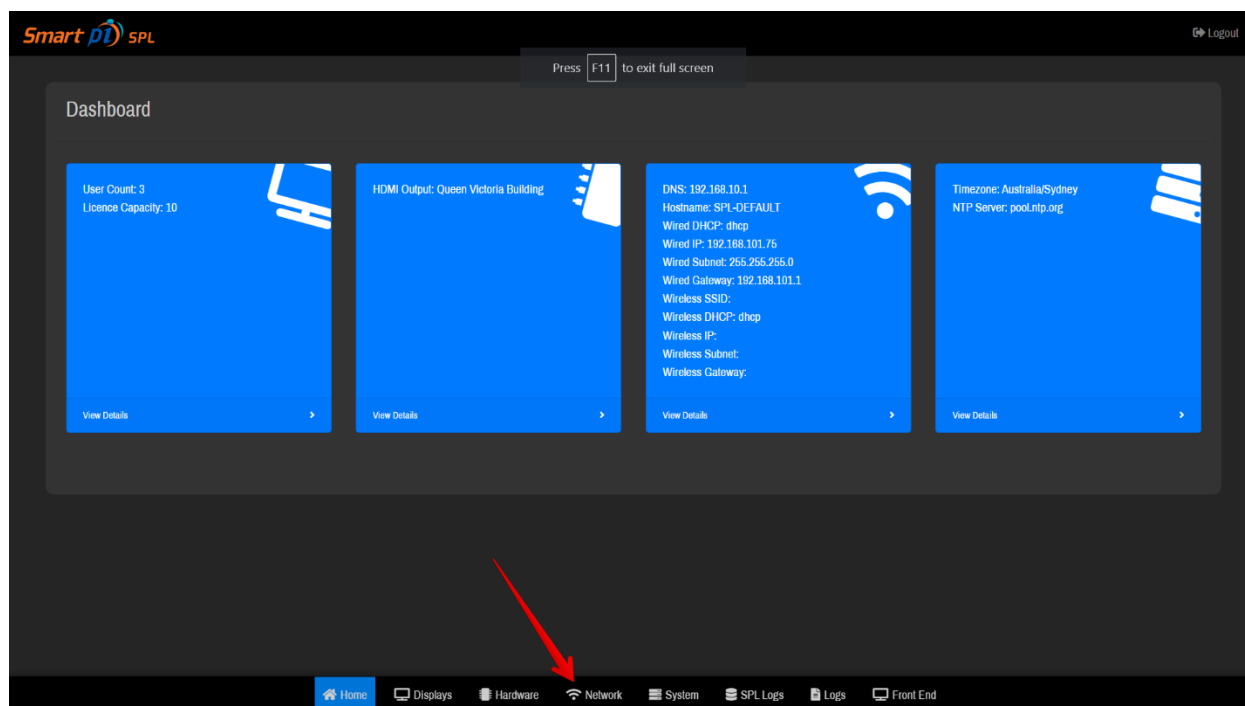
Select a Display and Click **Apply** to send it to the HDMI output.

5.5 Network settings

From the Dashboard side menu, clicking **Network** opens the Network configuration window.

CAUTION - changing Network settings may cause Smart pi SPL to become unreachable via the web browser. Experience with network configuration is a prerequisite for this section.

Hostname is the name that Smart pi SPL will assume on the network. Enter manually. Leave the NTP server as it is.

Wired settings are related to using an ethernet network connection for Smart pi SPL.

Wireless settings are for using a wireless network connection for Smart pi SPL.

Click the **Apply** button below the relevant section to save any changes.
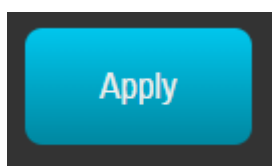
5.6 System settings

From the **Dashboard** side menu, clicking **System** opens the System configuration window. This facility controls important system functions and services.

> **CAUTION - System management settings have the ability to render Smart pi SPL in-operational.**
>
> **USE WITH CARE!**

5.6.1 LDAP

Lightweight directory access protocol (LDAP) is a protocol that makes it possible for applications to query user information rapidly. Set it up as per your preferences.

5.6.2 GLOBAL

Upload your custom logo here if you have one. Select **Browse** to upload an image to the system. The image file must be .jpg format and less than 5 mb.

You can also change the administrator password if you wish.
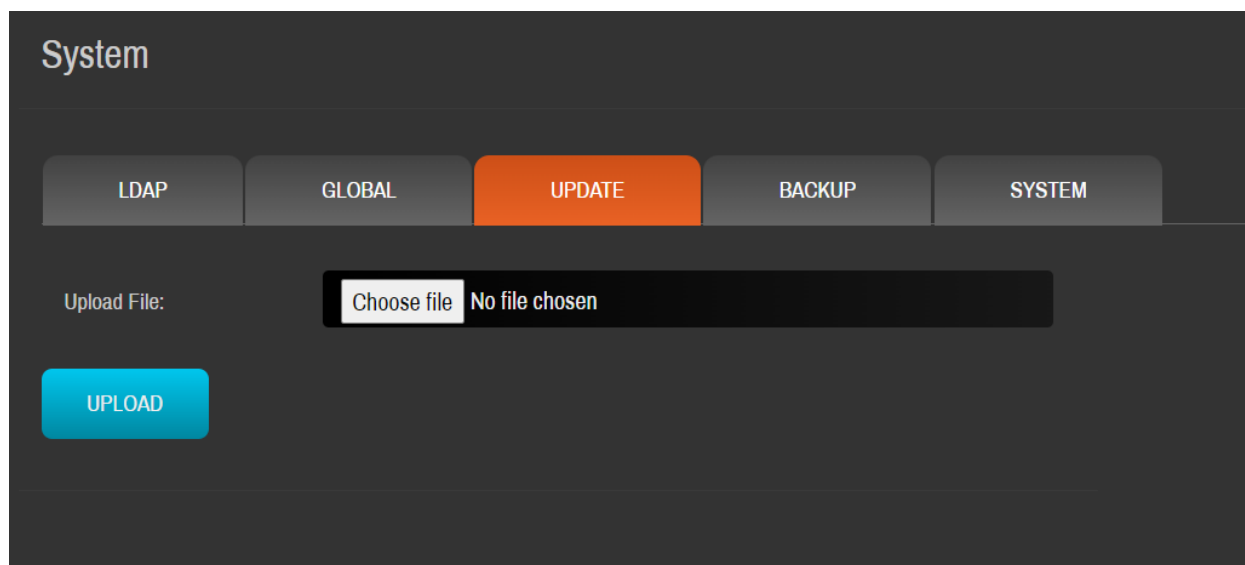
5.6.3 UPDATE
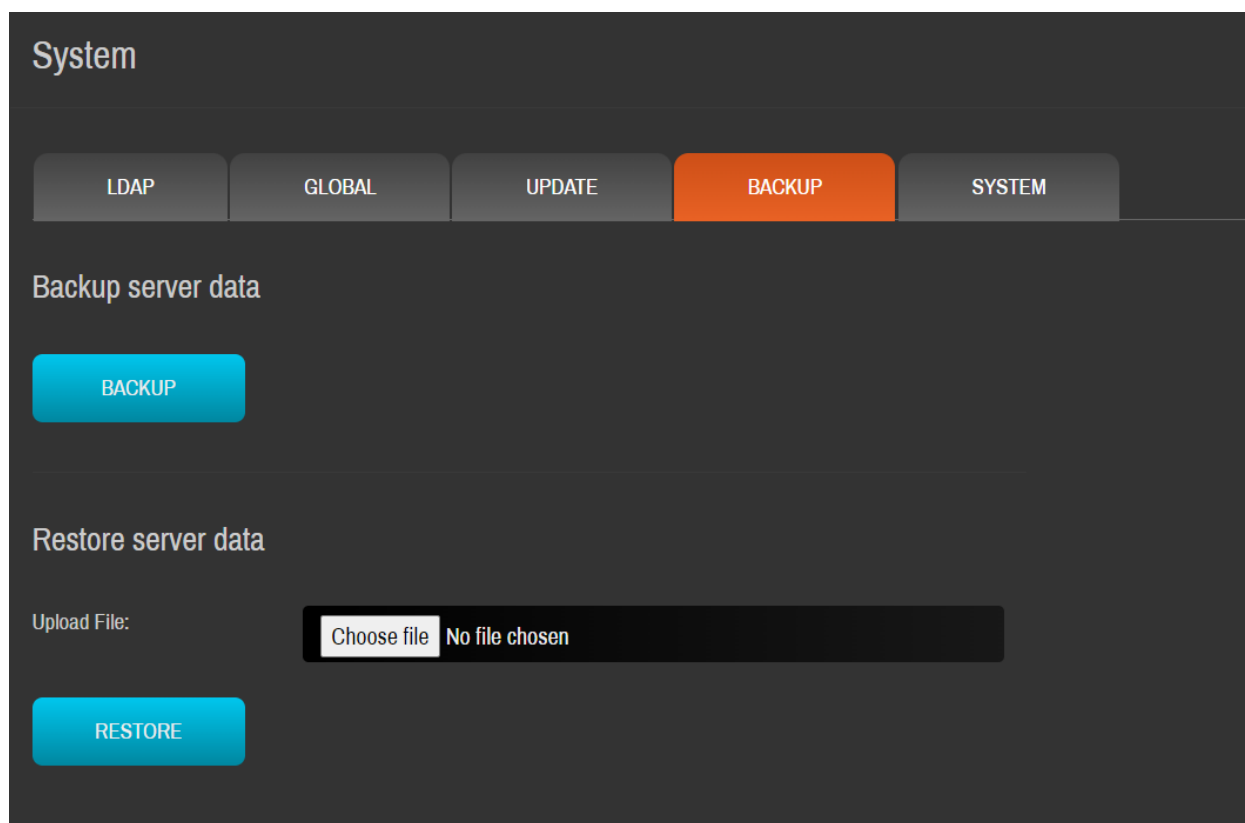
Select a software update file to upload by clicking **Choose file** and then select **Upload**.

5.6.4 BACKUP

Back up your server data by clicking the blue **BACKUP** button. This will initiate a backup of the system's database. A backup .sql file will be presented as downloadable to your web browser. Choose a location for the download if prompted by your computer.

You can also restore from a previous backup by clicking **Choose file** and then select **RESTORE**.
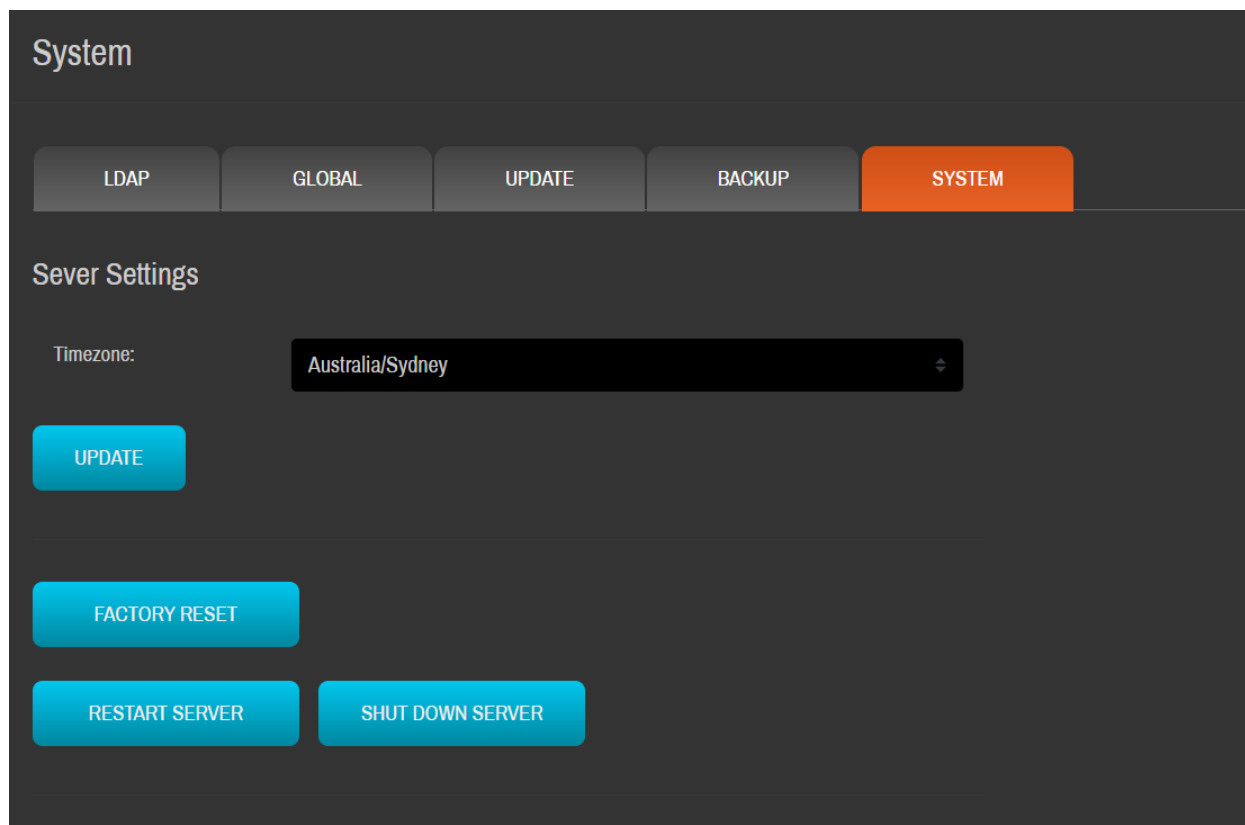
5.6.5 SYSTEM

Here you can change the timezone, do a factory reset to start over, simply restart the server or shut down the server.

Caution! Clicking **FACTORY RESET** will factory reset Smart pi SPL. Any current systems data, settings and SPL logging data will be unrecoverable after the reset operation.

Clicking **RESTART SERVER** will initiate a system restart. The unit will not power down during this process.

Caution! Clicking **SHUTDOWN SERVER** will initiate a complete system shutdown and power down of Smart pi SPL.

5.7 SPL Logs settings

Click SPL Logs from the **Dashboard** to access the SPL log settings.

Choose the start date, end date and channel and hit **SEARCH**.

Scroll down a bit to see the SPF logs and you can also download these in a .CSV format by clicking the **EXPORT** button. Change the **Channel** to view/download logs related to each channel.

SPL Logs	Calibration Logs

Channel 1

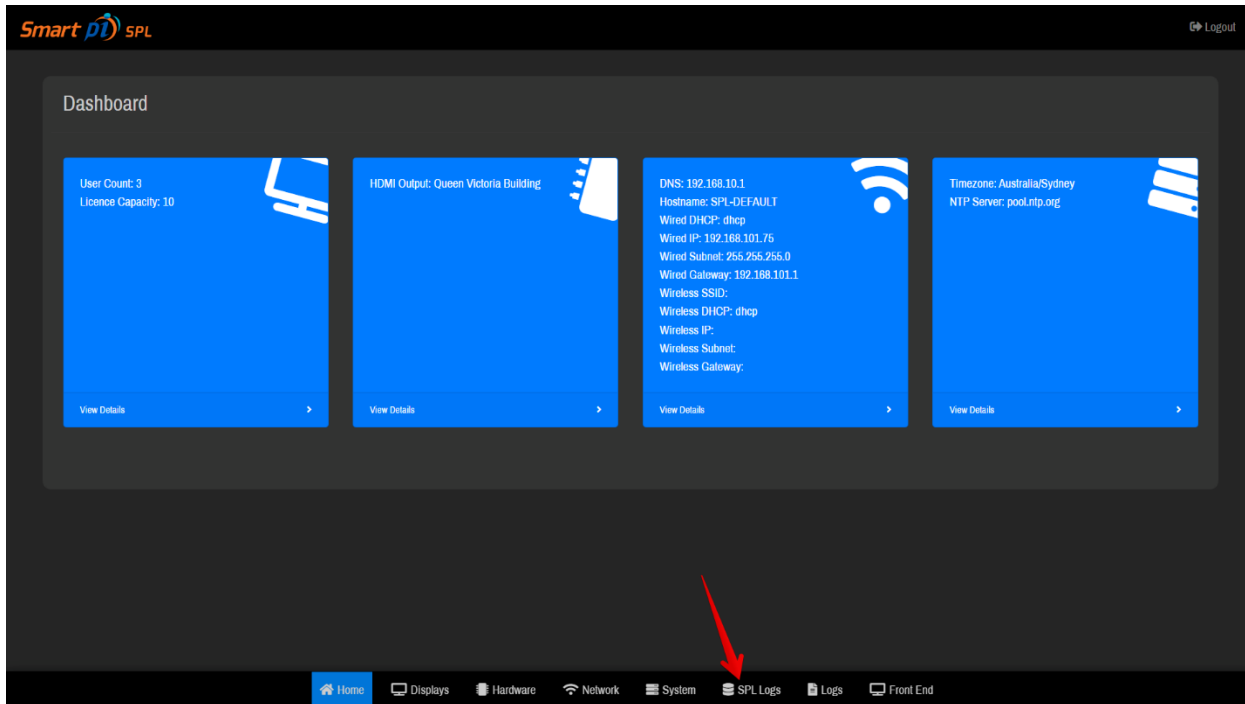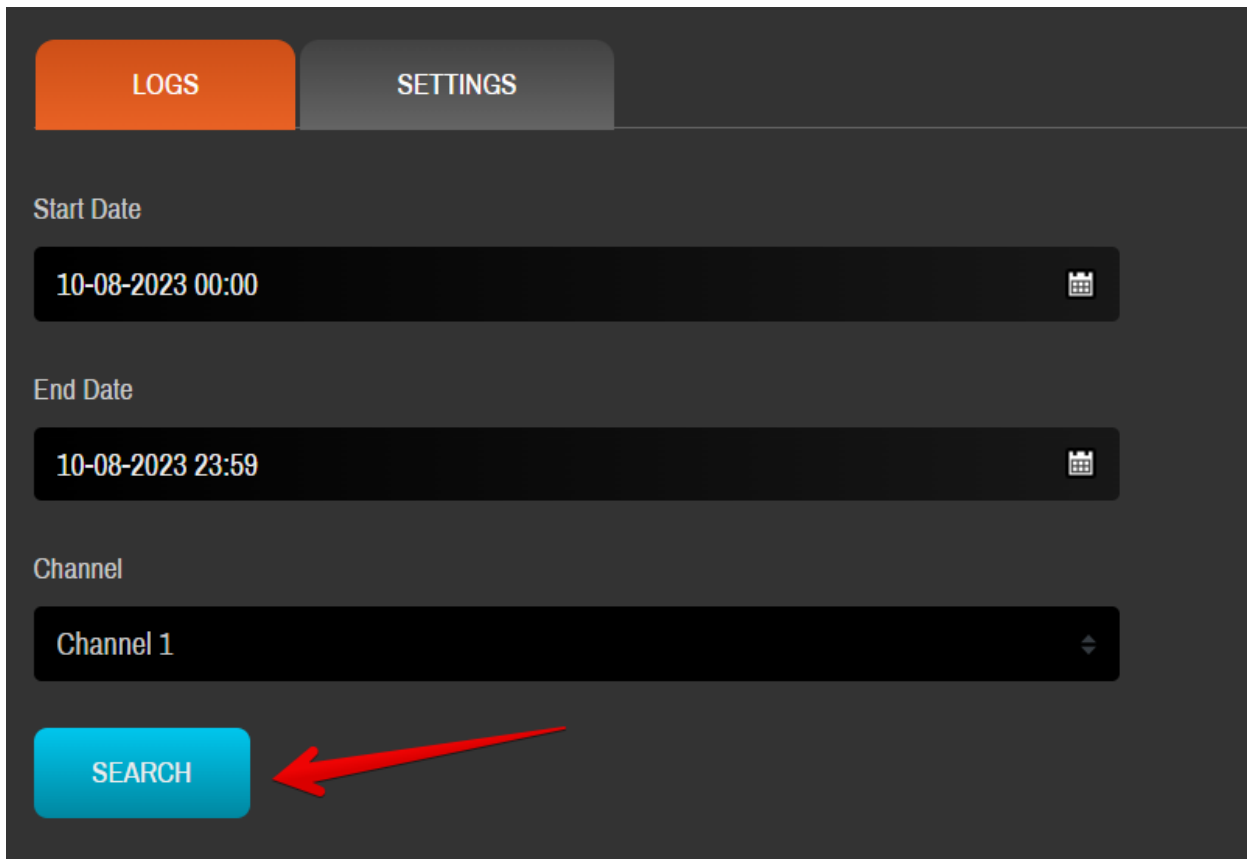| Timestamp	SPL 1 DBA 1s	SPL 1 DBC 1s	SPL 1 DBA 10m	SPL 1 DBC 10m	SPL 1 DBA 15m	SPL 1 DBC 15m	SPL 1 DBA 60m	SPL 1 DBC 60m	SPL 1 DBA 90m	SPL 1 DBC 90m
10/08/2023 19:59:28	52.2203	61.9383	48.1471	57.9171	48.0282	57.9031	47.7347	57.7152	47.5241	57.4002
10/08/2023 19:59:29	43.3628	55.1798	48.1476	57.9182	48.0285	57.9035	47.7347	57.7154	47.5238	57.4002
10/08/2023 19:59:30	50.5863	58.3776	48.1585	57.923	47.9899	57.874	47.7367	57.7162	47.5247	57.4008
10/08/2023 19:59:31	44.1131	55.5675	48.158	57.9218	47.9681	57.8622	47.7351	57.7154	47.5244	57.4009
10/08/2023 19:59:32	41.7589	53.8013	48.1574	57.9217	47.9679	57.8619	47.7332	57.7138	47.524	57.4009
10/08/2023 19:59:33	42.4493	54.2764	48.1542	57.9208	47.9682	57.8626	47.7328	57.7136	47.5236	57.4008
10/08/2023 19:59:34	42.0707	54.3728	48.154	57.921	47.968	57.8626	47.7328	57.7137	47.5232	57.4008
10/08/2023 19:59:36	54.956	61.9687	48.1845	57.931	47.9907	57.8729	47.7381	57.7162	47.527	57.4027

Showing 1 to 8 of 100 entries

First Previous 1 2 3 4 5 … 13 Next Last

EXPORT

Hitting the Calibration Logs button would provide you with the recent calibration logs. Just like before, these can also be exported in a .CSV format by clicking the **EXPORT** button down below.

A complete listing of SPL measurements for a defined time period (max 365 days) can be downloaded as a .csv file from this page. Before downloading logs, make sure the right are displayed in the Log Table. For example, if SPL logs are displayed, then that is what will be downloaded. Likewise, if Calibration Logs are selected, they will be downloaded. Note, Download All will initiate the export of ALL SPL / Calibration data currently on the system.

For SPL readings, this is a considerable amount of data and may take a few minutes to complete.
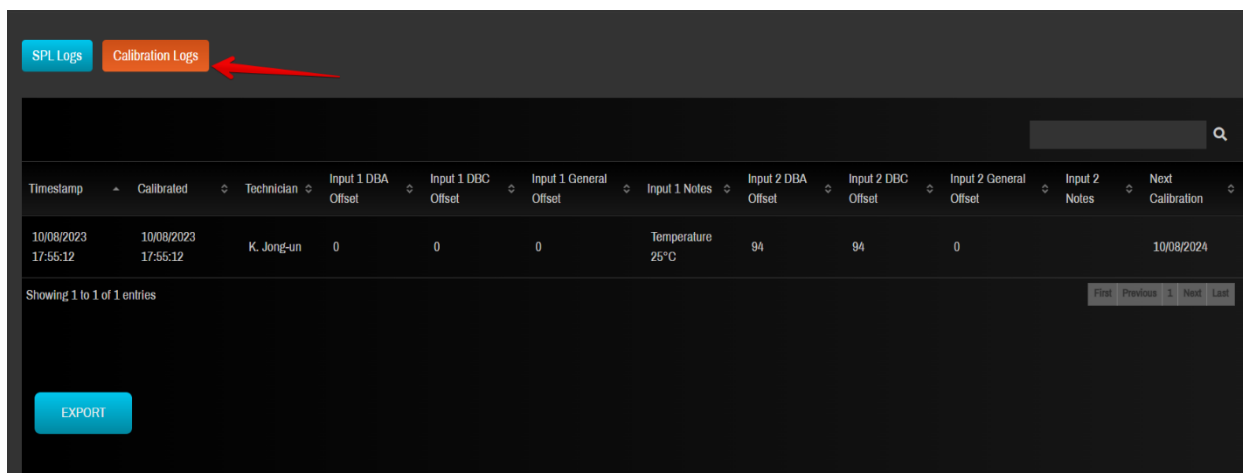
To change the log duration, click **SETTINGS** and change the number of days for which you'd like to save the logs.
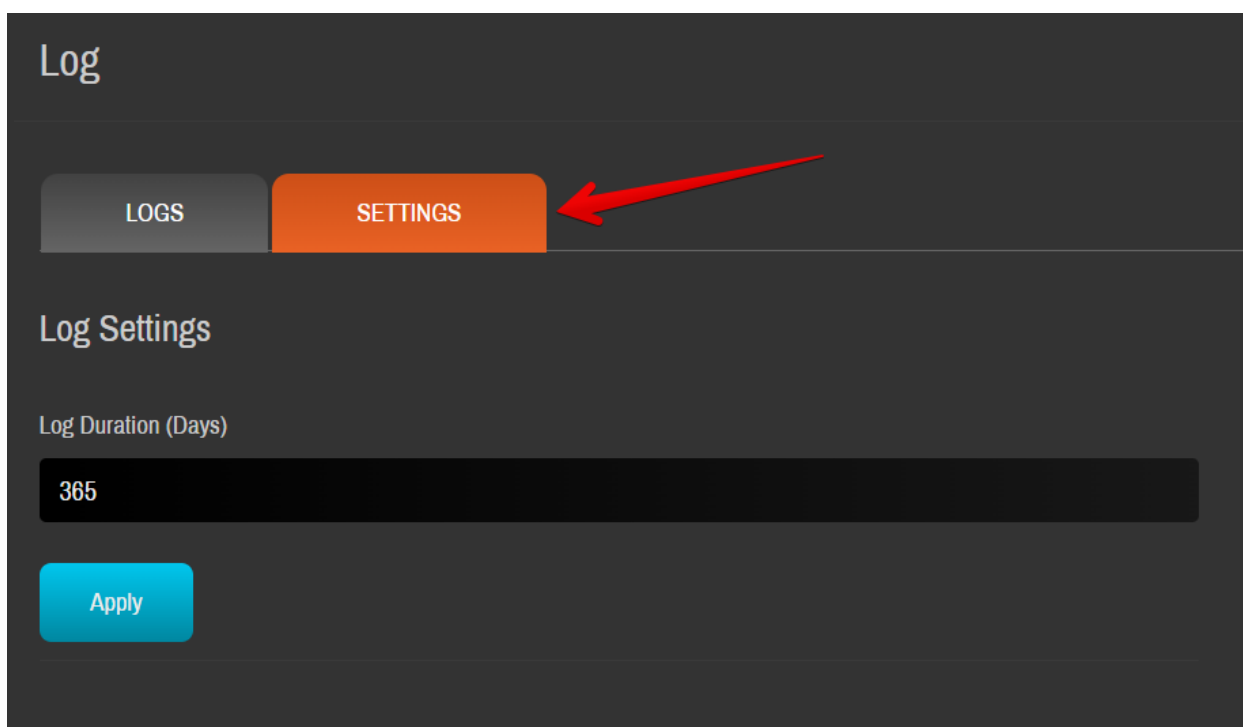
5.8 Logs

From the Dashboard menu, clicking **Logs** opens the Log Table window.
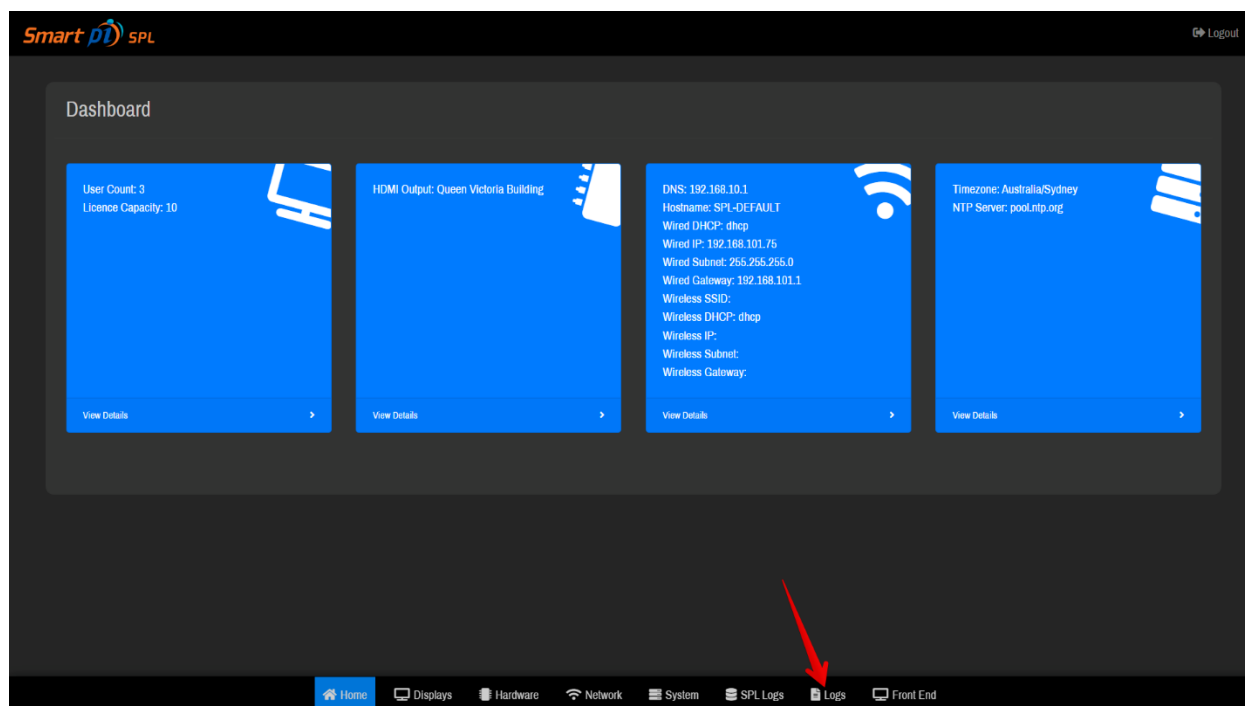
Choose the start date and end date, and click the **Search** button to see the logs. By default, the Log Table displays a date / time stamped view of the last 100 SPL measurements for both SPL Inputs in one second increments.
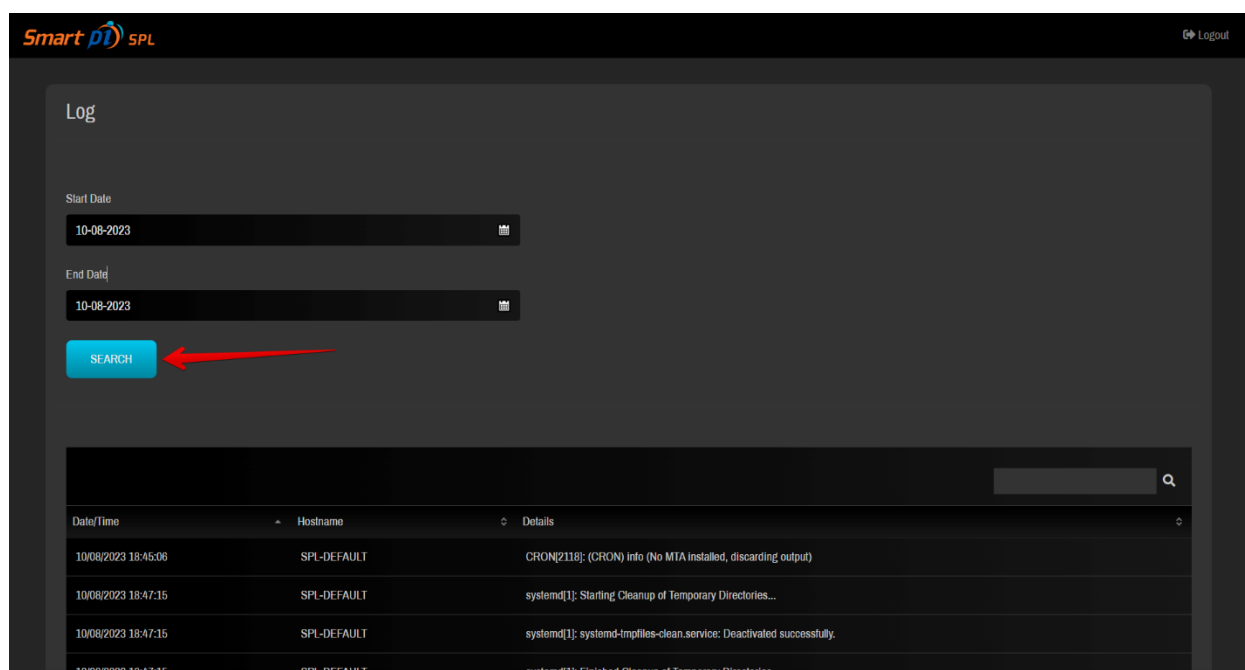
5.9 Front End

From the **Dashboard**, click the Front End button at the bottom. This will give a prompt that you will be logged out of the admin area. Click **Yes** to proceed.
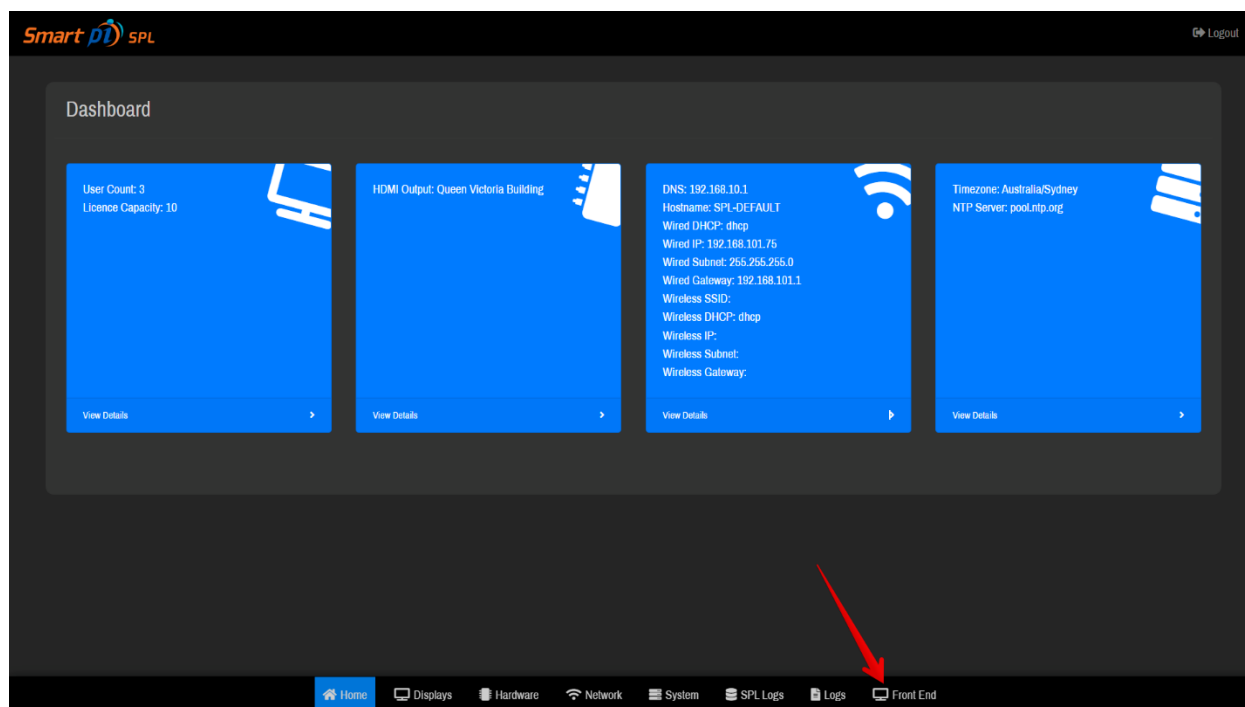
Next, you will get to choose from all your active Displays.

Selecting one will take you to the screen showing how your display looks like.

6. CALIBRATION

Regular calibration (once per month) of your Smart pi SPL and SPL microphones is of paramount importance for compliance with government mandated sound level monitoring. Calibration ensures the accurate conversion of e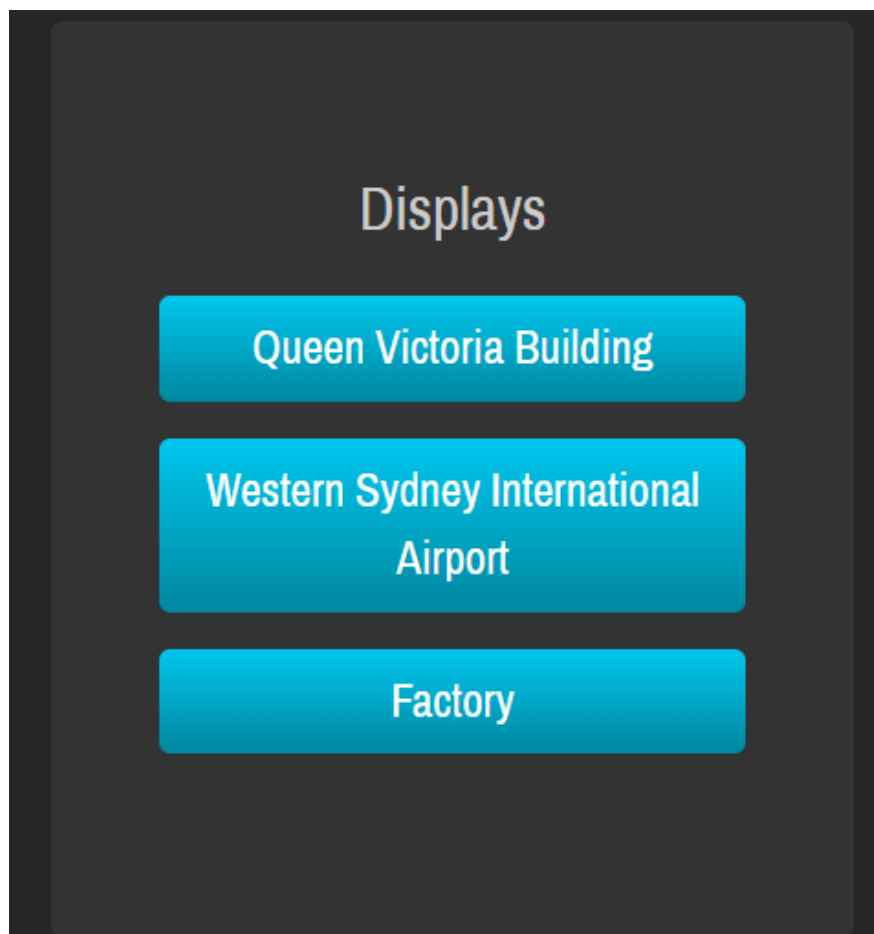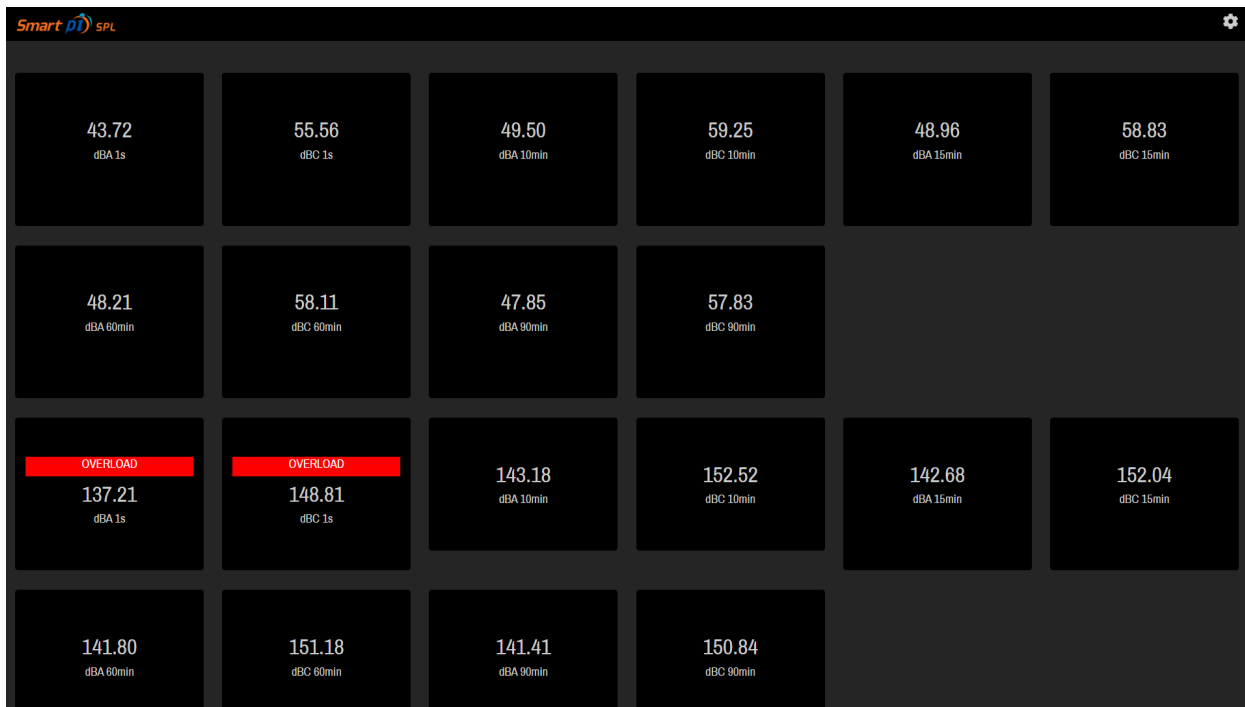nvironmental sound level to SPL logging data - which is what an organisation's sound output profile will be judged upon.

Calibration requires a purpose build sound calibration device. Smart pi recommends the BWSA Tech Sound Calibrator CA114/115. During a properly set up calibration procedure, this device generates an exact 94dB equivalent SPL at the microphone diaphragm.

When calibrating, Smart pi SPL will expect a microphone input SPL of exactly 94dB, and any deviance from that measurement (due to microphone variances) with be automatically adjusted for by the Smart pi SPL system. Each microphone must be calibrated individually with the actual Smart pi SPL input that it will serve. This ensures fidelity and true SPL measurement readings from each microphone and input.

> The following instructions assume a correctly setup and configured Smart pi SPL, input SPL microphones (x2) and third party sound calibration device. Please refer to the manual of your chosen third party sound calibration unit for its particular setup instructions

From the Dashboard menu, click Hardware to open the Hardware configuration window.
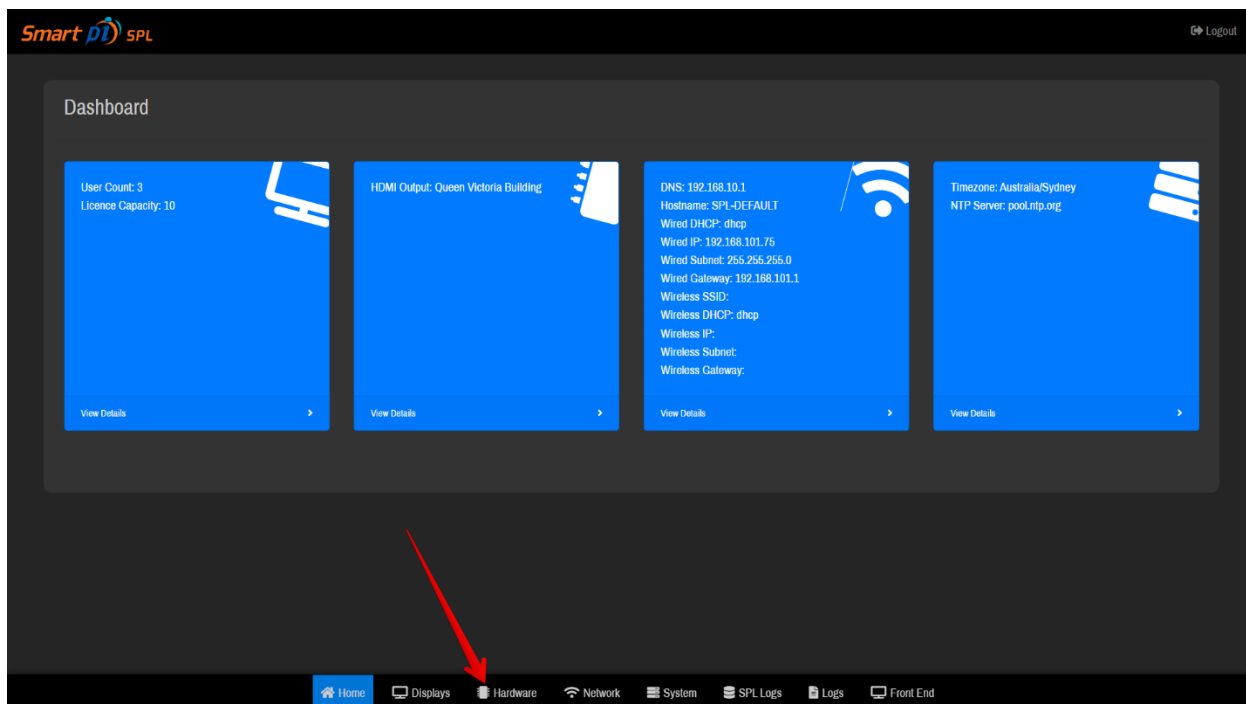
Click Calibrate to initiate the calibration procedure.
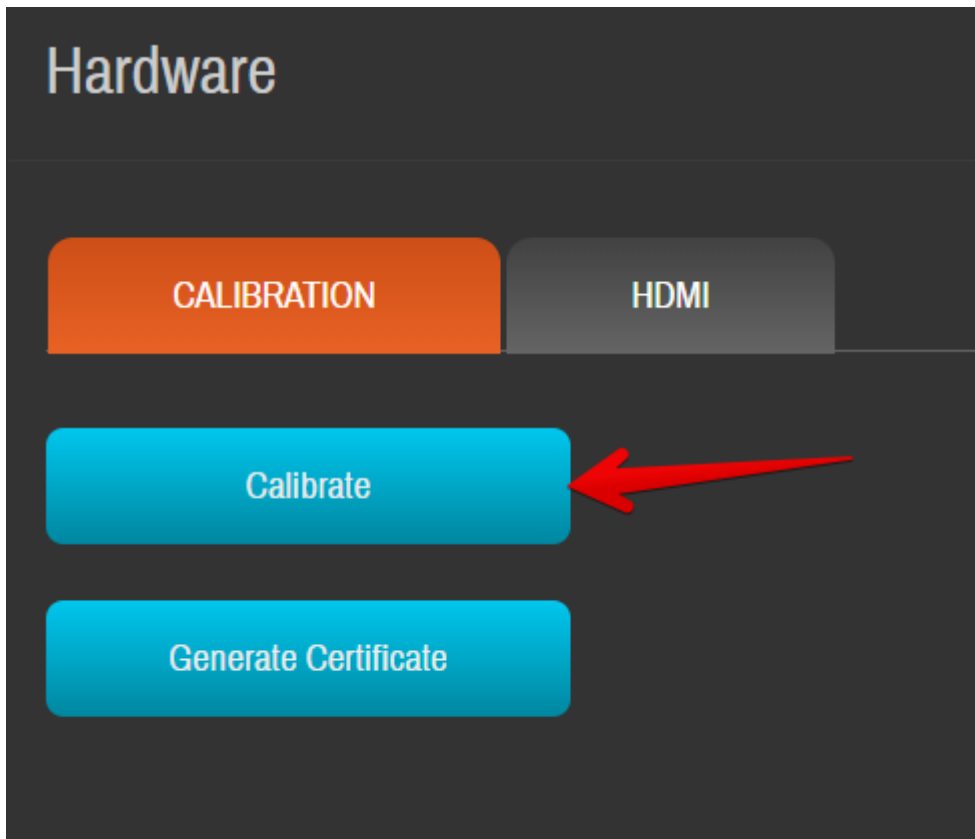
For an initial calibration, the Calibration Form will be empty. For subsequent calibrations, the details of last calibration are retained, and will be seen next time this window is opened. The details can of course be changed.

Complete the form details and click Next.

The first test will Calibrate Input 1. Ensure that your sound calibration device is correctly positioned and is serving a 94 dB sine wave sound output to SPL microphone 1. Then click the green **Run Calibration Test** button to begin the calibration. The test will take approximately 10 seconds to complete.
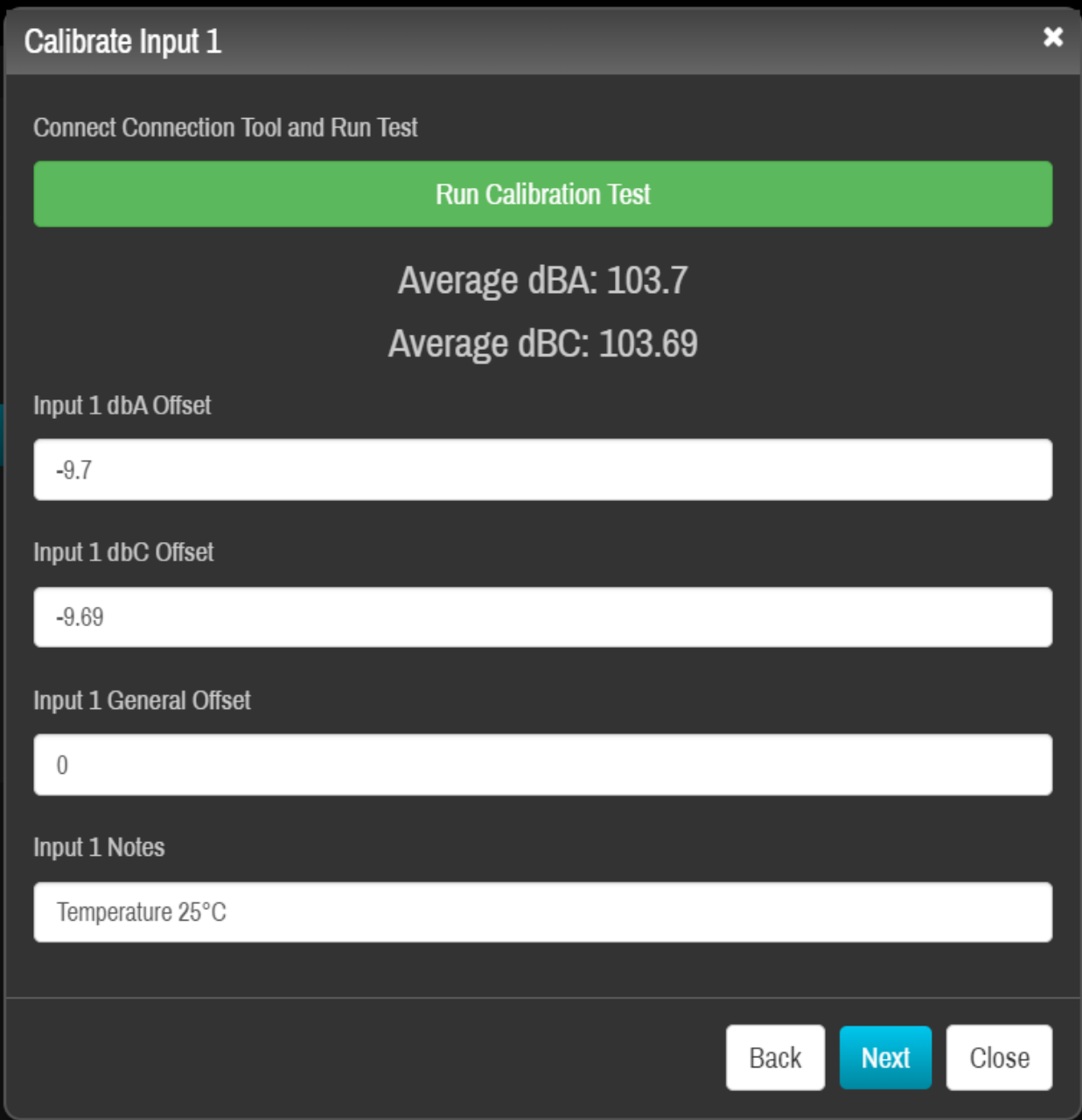
In this example, the actual average input was calculated as 103.7 dBA and 103.69 dBC.
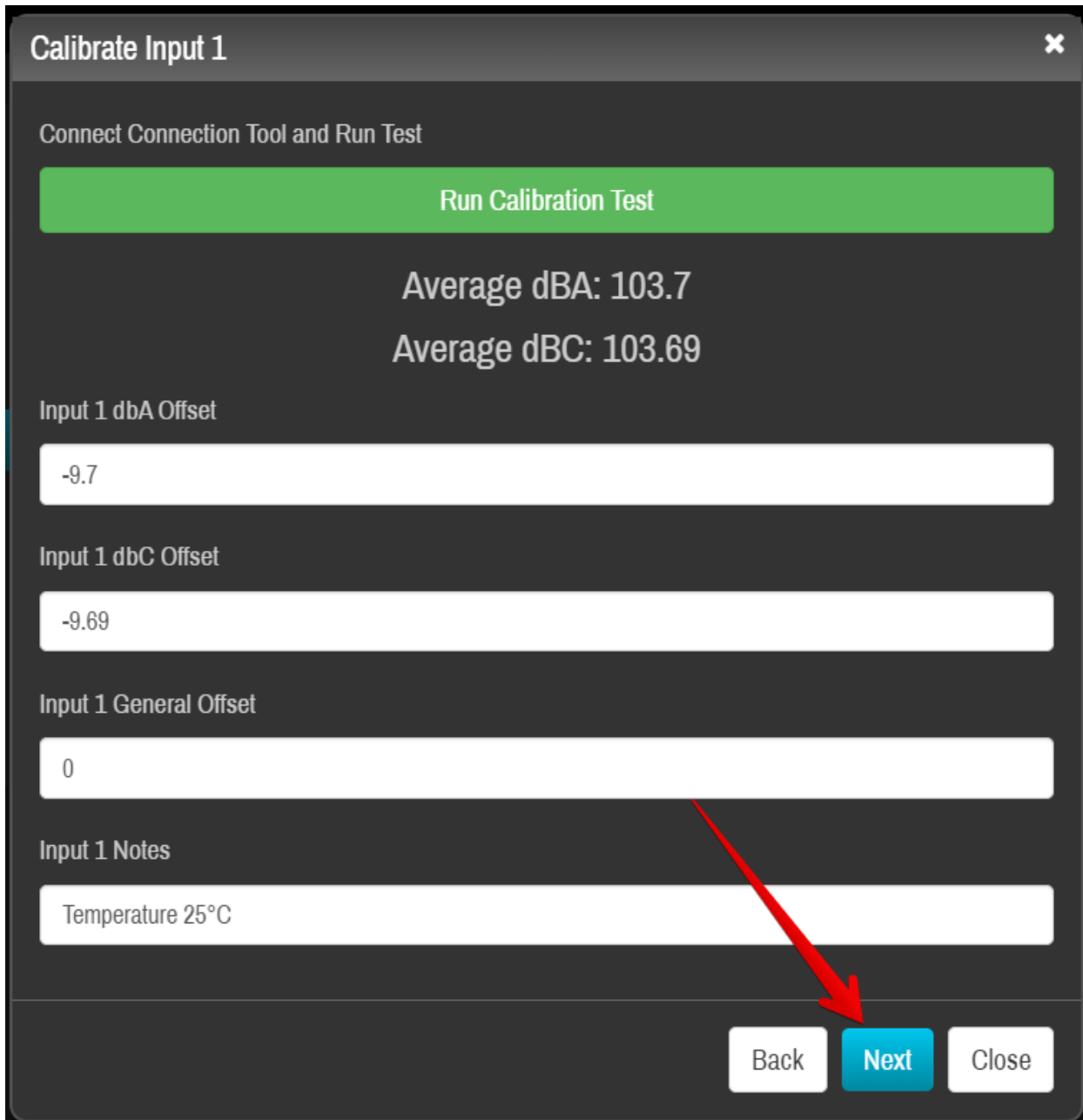

The input is greater than 94 dB and so the unit compensates with respective Input Offset attenuations of -9.7 dB and -9.69 dB. These offsets will apply to all future input from microphone 1, until the next calibration is performed.

A General Offset may also be applied by the operator for use when, post calibration, the SPL microphones cannot be placed near the main sound measurement source. For example; a sound source measures 60 dB, but at 5 m distant, the measurement is 50 dB. This would require a manually applied General Offset of +10.00 dB in order to correctly record the SPL at that location.

A Notes text box is also available for the operator to include additional detail if required.

Click **Next** to repeat the exact same procedure for microphone Input 2.
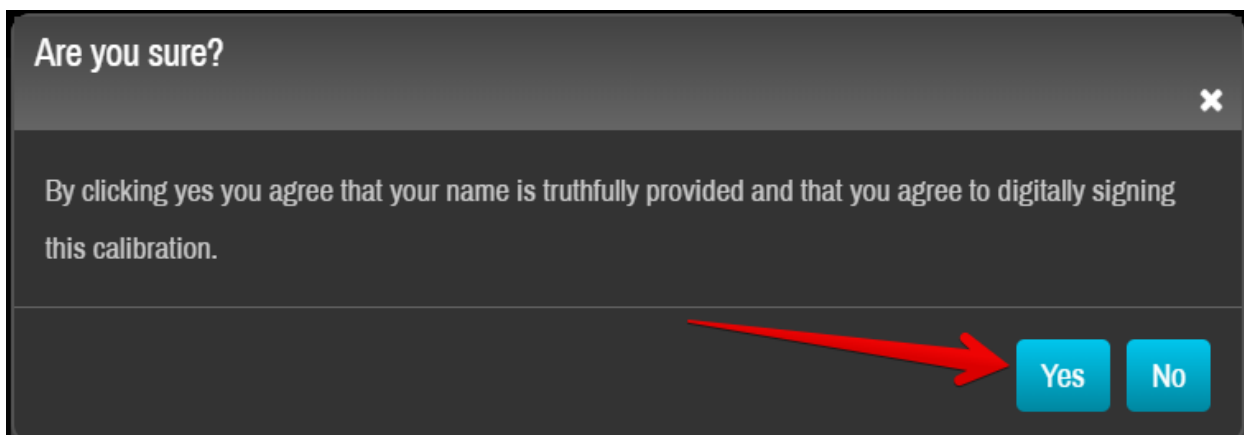
As before, the test measurements and corresponding offsets applied will be displayed, but for microphone Input 2 this time.

Clicking Apply will prompt Smart pi SPL to verify accountability for the calibration.

Click Yes to accept and return to the Hardware configuration window. A certificate of calibration can now be generated by Smart pi SPL.

Click **Generate Certificate** to download a corresponding calibration certificate (.pdf format) to your computer.
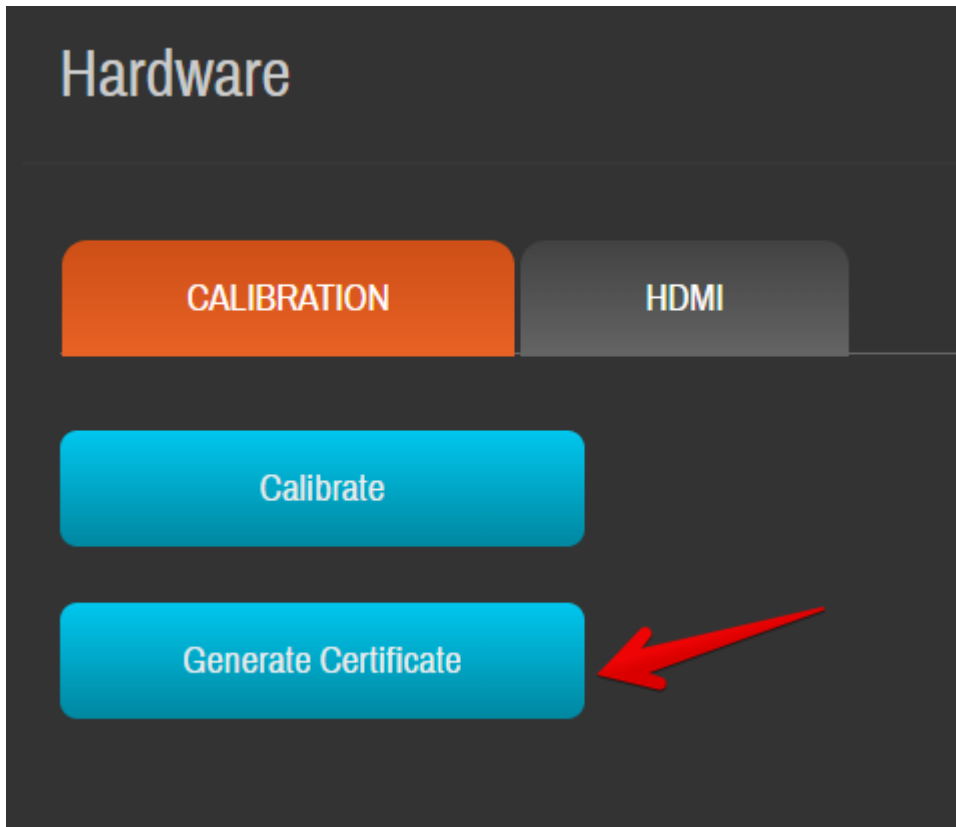
Calibration remains valid up to a SPL input of 124 dB - after which the system will report an overload state per second of SPL > 124 dB. Overload states will be highlighted by red notifications on the current display

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7. TECHNICAL DATA

Weight	250 g
Dimensions	Length 124 mm Width 130 mm Height 27mm
Operating temperature range	-40 °C to 85 °C
Power	5V DC (2A) microUSB power supply (240 VAC)
Input	w2x 3.5 mm TRRS jack (front): mic level - Class 2 pre-amp
Output	1x 2.5 mm TRS jack (rear) 1x 2.5 mm TRS jack (rear)
Connectivity	Ethernet RJ45 10/100 Mb WiFi - 802.11n 2.4 GHz 3x USB 2.0 port

REFERENCES

BWSA 2018, Sound Calibrator CA114/115 specifications 2018, available at <http://www.bswatech.com/web_proDetail.action?proId=374>, accessed 30.05.2018.

IEC 2013, International Electrotechnical Commission 2013, 'Electroacoustics - Sound level meters - Part 1: Specifications: International Standard IEC 61672-1:2013', International Electrotechnical Commission, available at <https://webstore.iec.ch/publication/5708>, accessed 28.05.2018.

MicW 2018, I-SERIES Mics specifications 2018, available at <http://www.mic-w.com/product.php? id=3>, accessed 30.05.2018.