VIGILANT Commissioning & Start-Up Guide

1.0 Overview

This guide outlines the step-by-step process to commission a VIGILANT system. Before the steps in this guide are started, the VIGILANT system should be installed per the steps outlined in the VIGILANT Installation Guide. When this guide is completed, the system will be considered operational without any further configuration required.

Document version: v01

Date last updated: August 12, 2024

2.0 Preparation

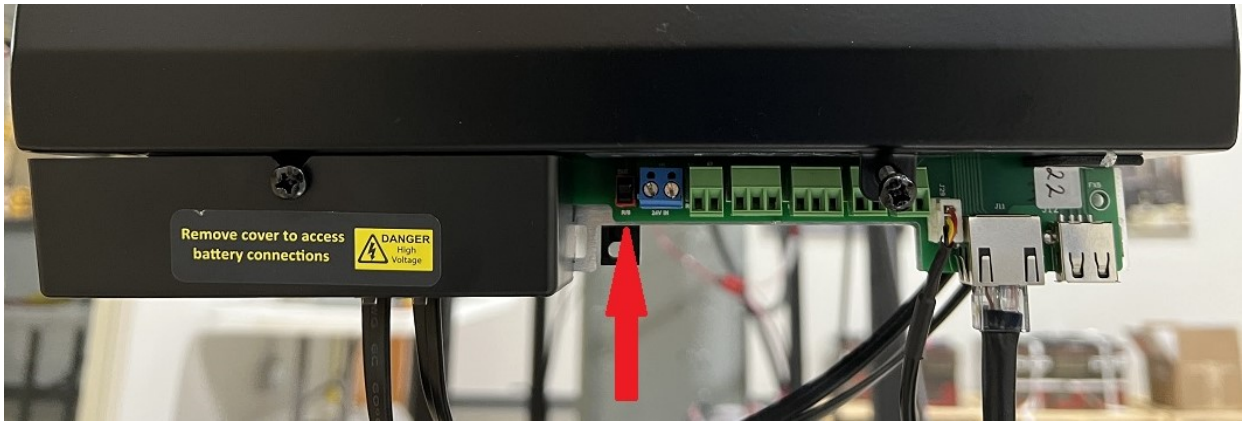
This section outlines the steps required prior to starting the commissioning.

2.1 Tools & Equipment

1. Multimeter - To verify input voltage and troubleshooting if needed.
2. #2 Phillips screwdriver - To open monitor covers and access power switch.
3. Ethernet cable - To connect monitor to computer.
4. Portable battery tester with ohmic measurement capability - For troubleshooting if needed.

2.2 Power on Monitor

1. Remove the left cover on the monitor and verify the voltage polarity.
2. Remove the front right cover from the monitor with the Phillips screwdriver.
3. Flip the power switch down to the ON position.
4. When the monitor powers on, the "Power On" LED will turn red until the Sensor Assignment section.



3.0 Connect to the Web-Interface

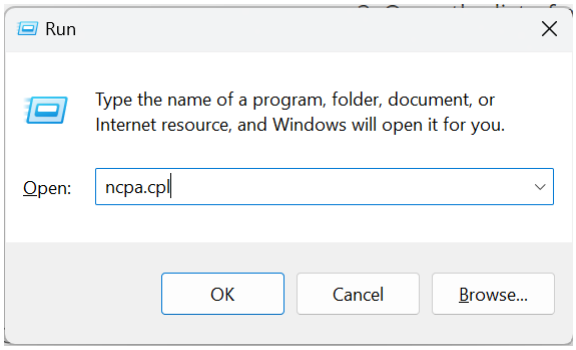
These steps will outline how to connect to the monitor and load the web-interface on the computer.

3.1 Establish Connection

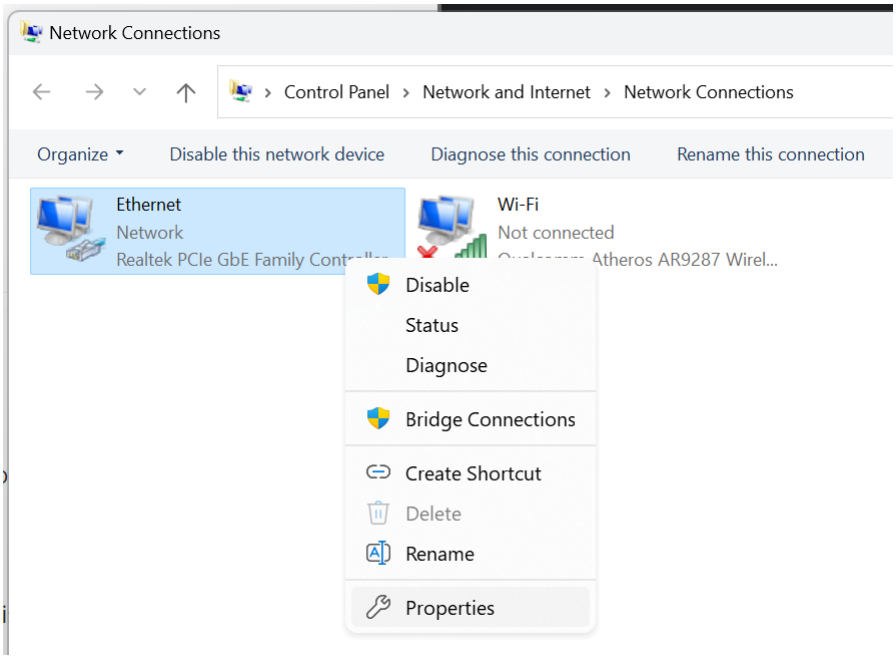
1. Connect the computer to the monitor using the Ethernet cable. There is only 1 Ethernet connection on the monitor as shown.

3.2 Configure IP Address

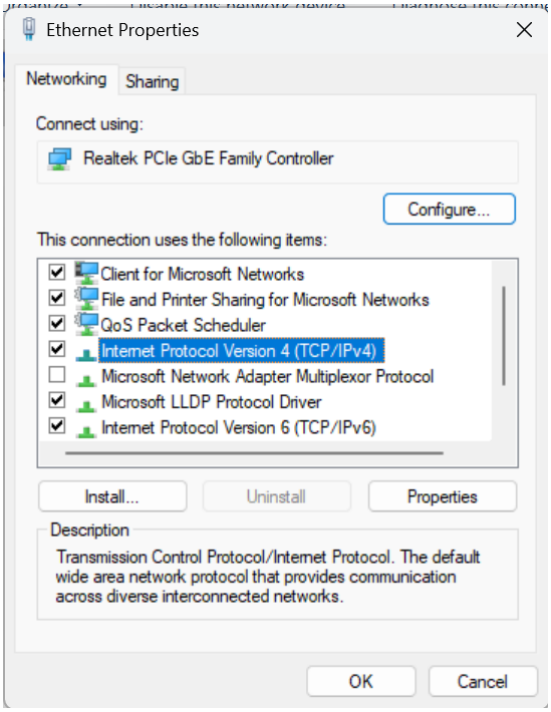
1. Open the list of network adapters. The most consistent way to do this on all versions of windows is to press **Windows Key + R** then type `ncpa.cpl` and press Enter.



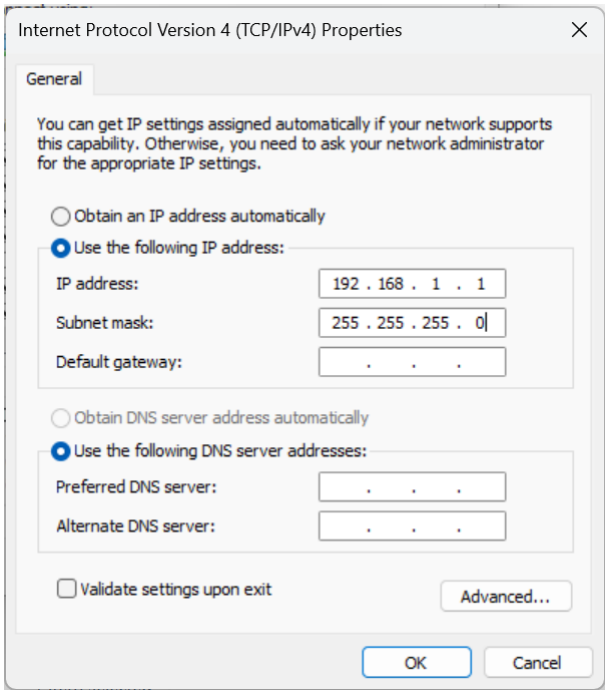
2. Find the network adapter that is connected to the VIGILANT. If unsure, consult your IT department. Once identified, right click it and select **Properties**.



3. Under the **Ethernet Properties** window, select **Internet Protocol Version 4 (TCP/IPv4)** and then click the **Properties** button. Ensure the checkbox to the left is checked.



4. In the **Internet Protocol Version 4 (TCP/IPv4)** properties window:
    - Click the **Use the following IP address** radio button
    - For IP address, enter `192.168.1.1`
    - For Subnet mask, enter `255.255.255.0`
    - Leave all other fields blank and click **OK**.

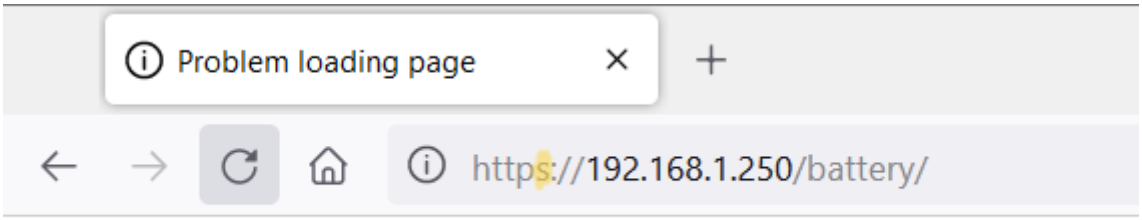


5. Close the **Ethernet Properties** window.

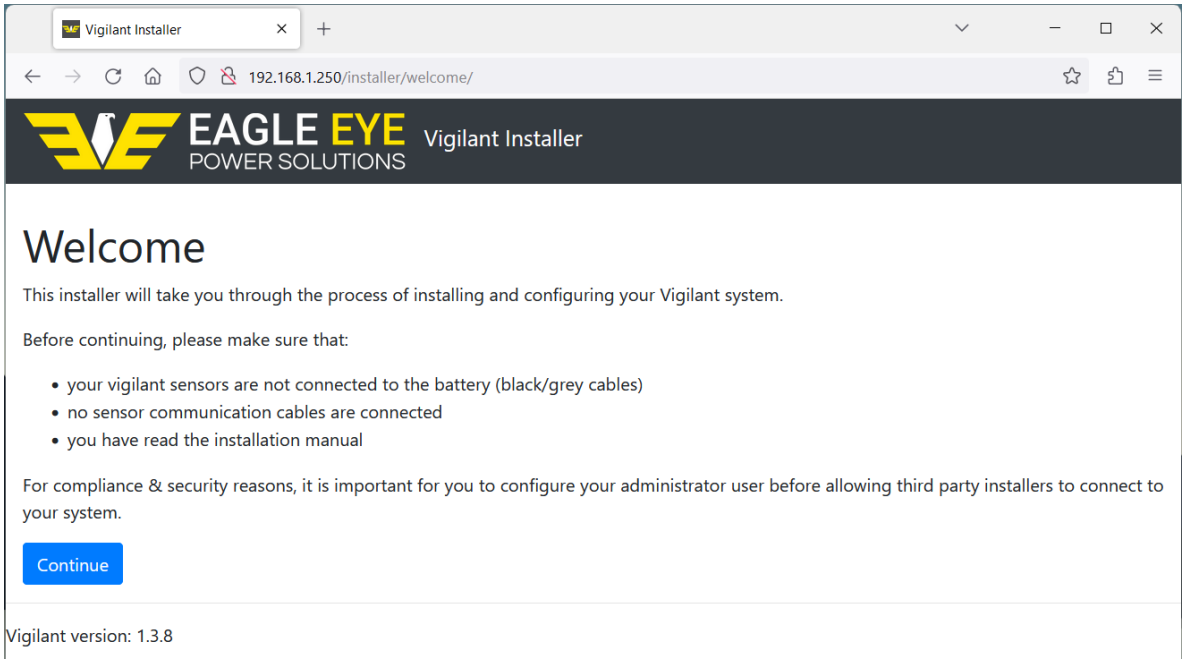
3.3 Establish Connection to Web-Interface

With the IP address of the computer configured, it's time to load the web interface. These steps will assume the IP address of the VIGILANT is set to the default of `192.168.1.250`.

1. Open a web-browser on the computer (e.g., Microsoft Edge, Google Chrome, Mozilla Firefox).
    - ***NOTE:*** *Internet Explorer is not supported and may cause errors during the commissioning.*
2. Type the IP address of the VIGILANT monitor into the web-interface and press enter.
    - If the page doesn't load, check to make sure the URL does not add an "s" after "http".



3. When the connection is successful, the welcome screen will be displayed.



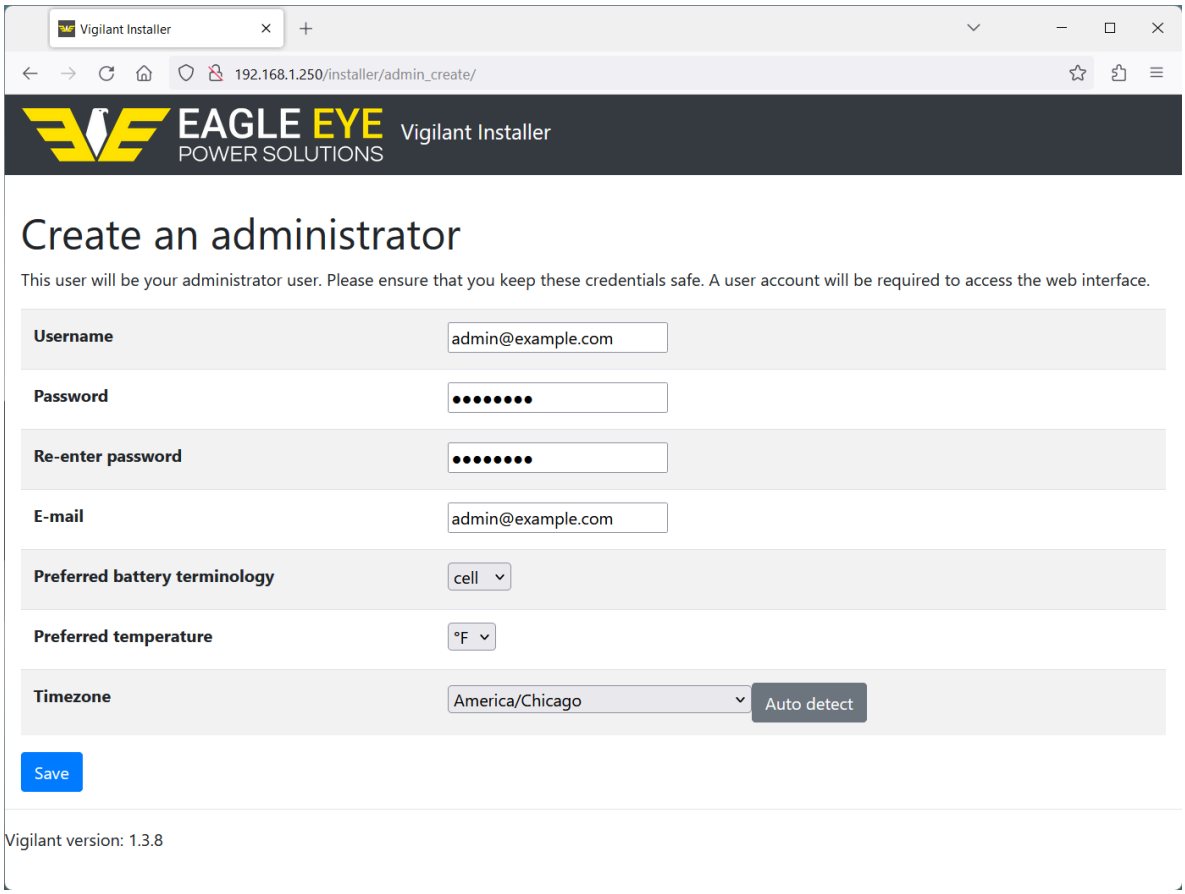
4.0 Create Users

4.1 Create Admin User

1. On the Welcome screen, click the **Continue** button.
2. The system will ask that an Administrator account is created, requiring completion of the following fields:
    - **Username**: The account username.
    - **Password**: Create a password with at least 8 characters.
    - **E-Mail**: This is the credential used to sign into the monitor. As of 1.3.10, the system does not have any email functionality.

- **Preferred battery terminology**: This is user preference, but general guidelines are below:
  - **Unit**: Newer term for 2 or more cells in a single enclosure (e.g., 6V, 8V, 12V).
  - **Bloc**: Term for 2 or more cells in a single enclosure (e.g., 6V, 8V, 12V)
  - **Cell**: Individual battery cell (e.g., 1.2V or 2V)
  - **Jar**: Historical term for 2 or more cells in a single enclosure (e.g., 6V, 8V, 12V).
- **Preferred temperature**: Select Celsius or Fahrenheit.
- **Time zone**: Select preferred time zone.

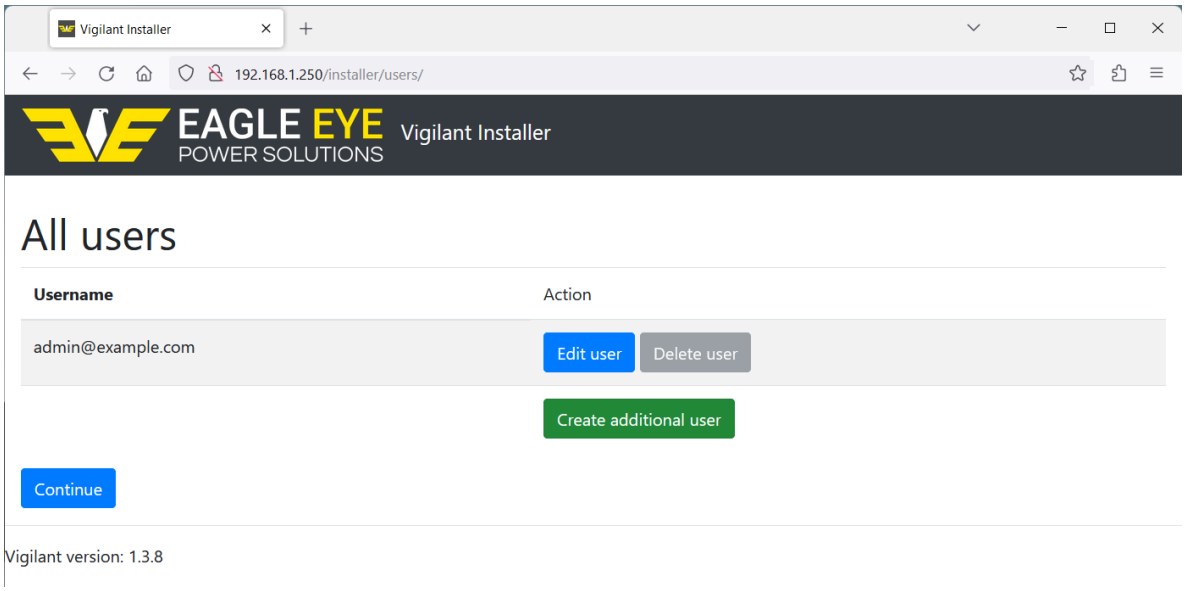
3. Click the **Save** button to create the user.



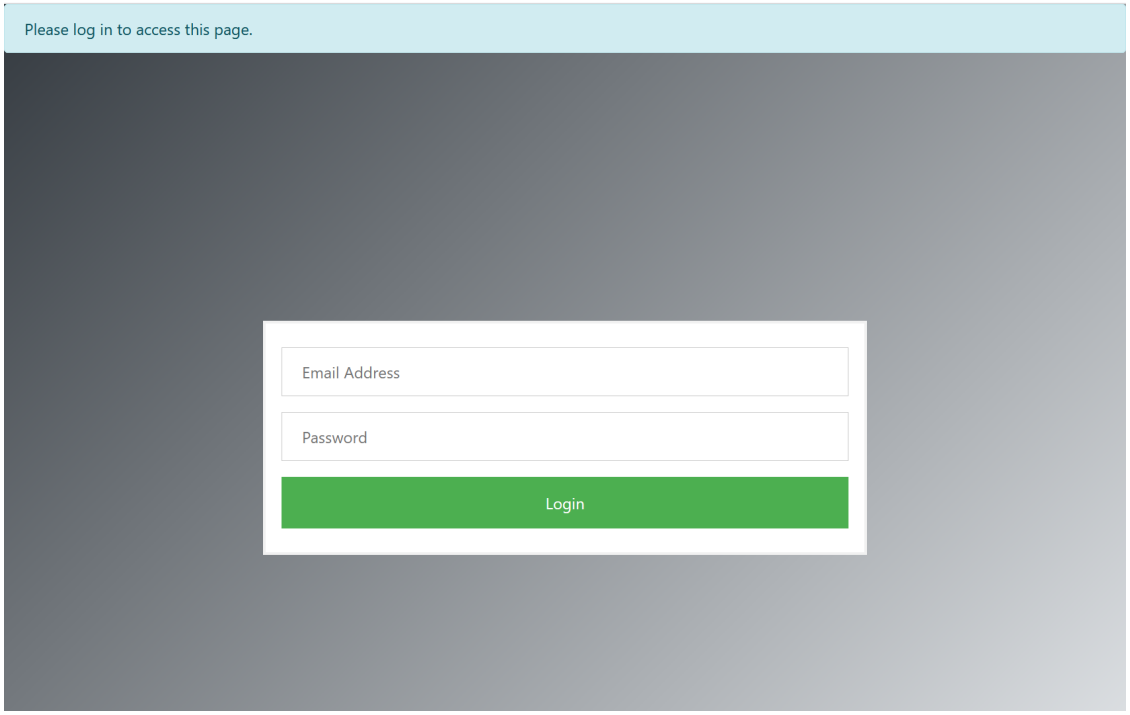
4.2 Create Other Users

Additional users can be created after the admin user. Note as of 1.3.10, users cannot be created after leaving this page. Be sure to create all users before clicking continue. A future update is in progress that will allow users to be created after commissioning. This update will also introduce user roles.

1. After creating the admin user, additional users created by clicking the **Create additional user button**.
2. Follow the same steps outlined in 4.1 to create the user.
3. Once all users are created, click the **Continue** button to proceed.



4. The system will require the Administrator user to login to continue commissioning.



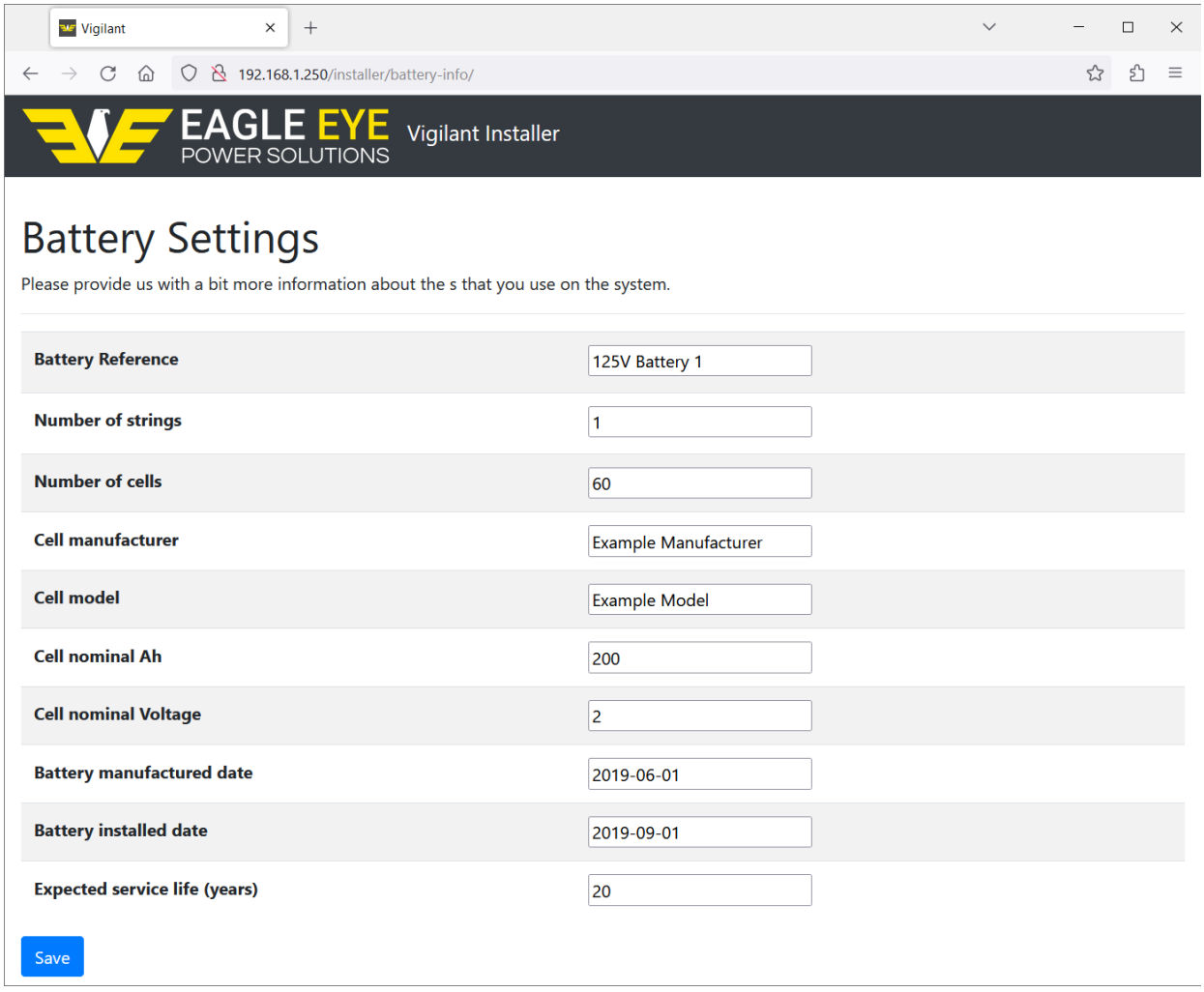
5.0 Enter Battery Information

The **Battery Settings** page requires information about the battery system to be entered. In the outline below, cells was chosen however the term "cells" could be units, blocs, or jars based on the terminology chose in step 4.1.

1. Complete the form as described below:
    - **Battery Reference**: Enter the name of the battery system.
    - **Number of strings**: Enter the number of parallel strings in the battery. If there is only one, type “1”
    - **Number of cells**: Enter the number of cells to be monitored.
    - **Cell manufacturer**: Enter the manufacturer of the battery.

- **Cell model**: Enter the model of the battery.
- **Cell nominal Ah**: Enter the nominal amp-hour.
- **Cell nominal Voltage**: Enter the nominal cell voltage. It's very important to input the nominal voltage of the cell as follows:
  - 1.2V = "1.2"
  - 2V = "2"
  - 4V = "4"
  - 6V = "6"
  - 8V = "8"
  - 12V = "12"
  - 16V = "16"
- **Battery manufactured date**: Enter the date the battery was manufactured.
- **Battery installed date**: Enter the date the battery was installed.
- **Expected service life (year)**: Enter the expected service life of the battery after installation.

2. Double check all information is correct, then click the **Save** button to continue to the next section.

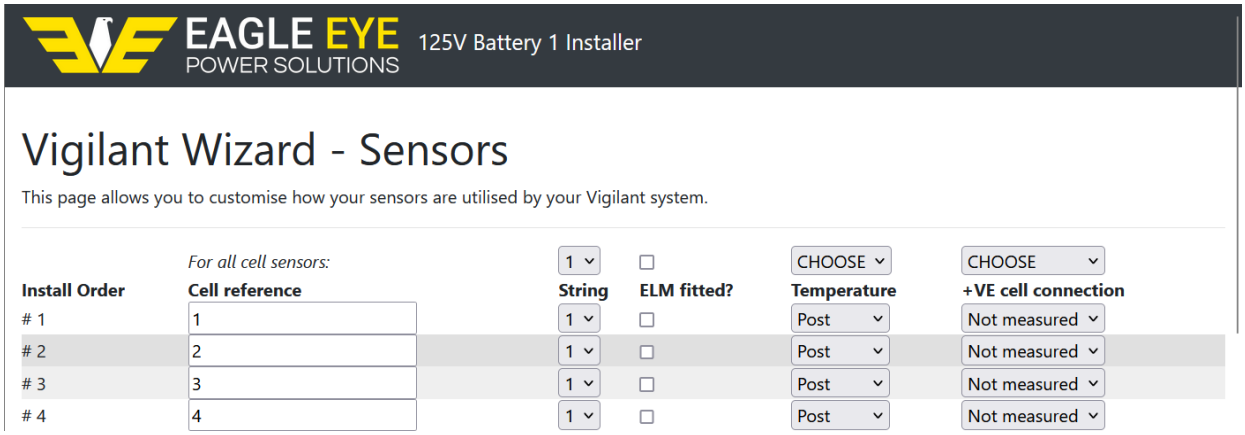


6.0 Configure Sensors

This section outlines steps to configure the sensors to ensure they work correctly for the battery being installed on. There are general steps which need to be adjusted per the specific battery configuration.

6.1 Configure Standard Sensors

The VIGILANT requires a single sensor for every cell voltage measured. These are considered the standard sensors. The steps below outline how to configure them.



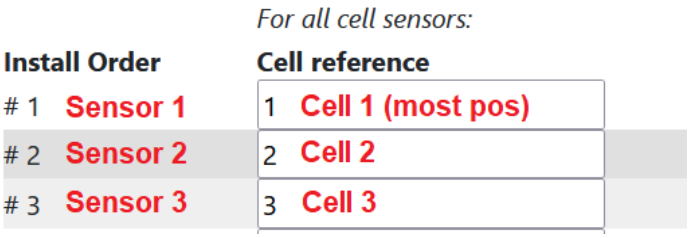
6.1.2 Install Order

A list of numbers is displayed for however many cells are on the system, starting at #1 for Sensor 1. No steps are required for this column other than to understand that each number corresponds to a sensor.

6.1.3 Cell Reference

This step assigns each sensor to a specific cell on the battery. The steps vary depending on if the battery cell numbering starts at the most positive or negative end of the string. Regardless of the cell numbering, the install order of sensors must start at the positive end of the string.

1. **When cell 1 starts at the positive end of the string:** This is the default configuration shown above. The **Install Order** shows sensor #1 assigned to cell 1. Leave these settings as is if the cell numbering starts at the positive end of the string.



2. **When cell 1 starts at the negative end of the string:** For this scenario, the installation should still go from positive to negative. But assigning the sensor IDs will just start at the negative cell, not including the "+1" sensor. So on a 60 cell/sensor system, the sensor on cell 60 (the most negative cell) will need to be plugged in first, you would go sequentially towards the most positive cell, but then the +1 sensor would be plugged in last.

- ***For Example:*** *On a -48V battery cell #1 is at the negative end of the string. In this scenario, sensor #1 under* ***Install Order*** *would be assigned to cell 24.*

6.1.4 String

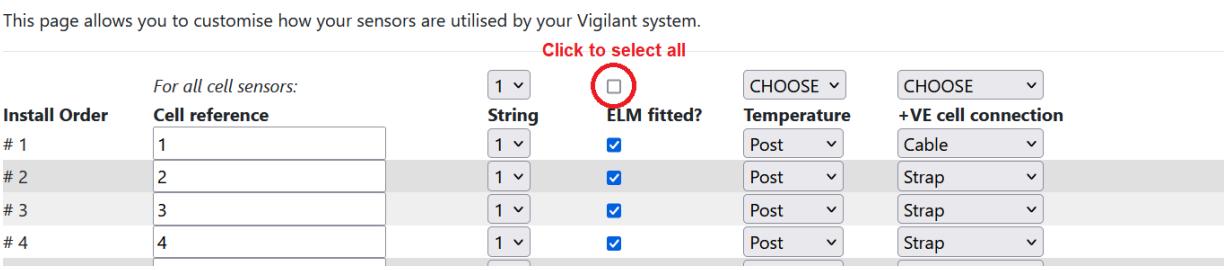
Select the string number that each sensor and cell are assigned to.

1. **Single string in series:** If installing on a single string, the value for all sensors should be set to "1".
2. **Series-parallel battery strings:** If installing to multiple strings in parallel, select the string number that the corresponding sensors will be installed to.

6.1.5 ELM fitted?

If installing the ELM electrolyte level sensors, check the box for each VIGILANT sensor that will be assigned an ELM. In most cases, just click the box above "ELM fitted?" to add the ELM to all sensors.

- ***Note:*** *It can take up to 30 seconds for all sensor to be assigned. During this time, the page may be unresponsive.*



6.1.6 Temperature

Select from the dropdown "Post" for all standard sensors. This confirms that each sensor is measuring the negative post temperature via the temperature sensor in the harness.

- ***Note:*** *It can take up to 30 seconds for all sensor to be assigned. During this time, the page may be unresponsive.*

6.1.7 +VE cell connection

This sets the type of intercell connection that each sensor will measure. For each sensor, the intercell connection is measured before the sensor. There are 3 interconnection types to select for each sensor:

- **Cable**: This refers to measurement of the charger cable. For this step, select "Cable" for sensor 1 only. It will also be selected for the +1 sensor in section 6.2.
- **Strap:** This refers to measurement of all the fixed length straps and can refer to a cable or bus bar. Select this for all interconnections that have a fixed length.
  - ***Tip****: Select strap from the top dropdown first to apply strap to all sensors. Then change only the sensors which are cable or intertier after to save clicks.*
  - ***Note****: It can take up to 30 seconds for all interconnects to be assigned. During this time, the page may be unresponsive.*

- **Intertier:** This refers to any longer cables between rack tiers, splits, etc. These will typically have a higher resistance than the strap values.

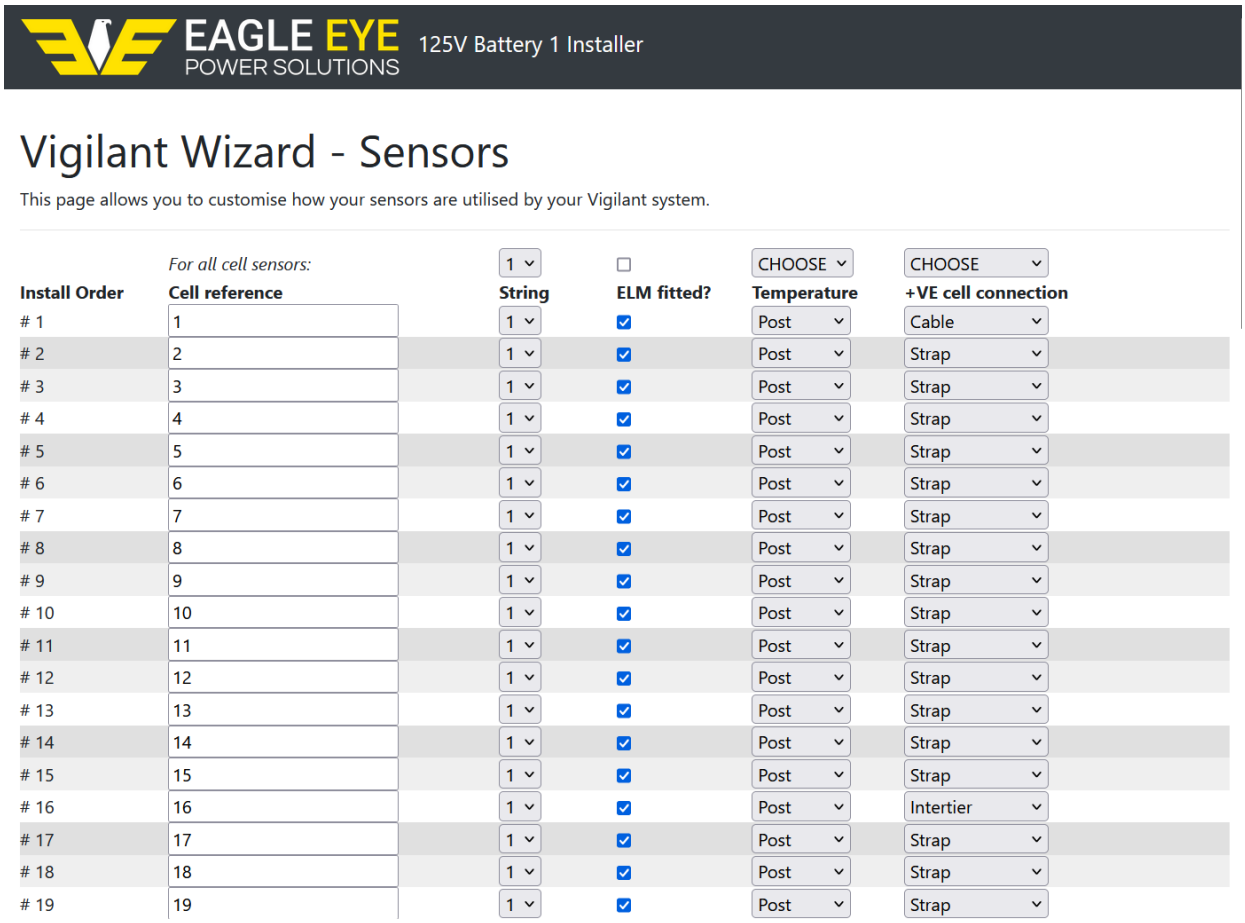
Below is an example of how this would be set up for a typical 24-cell battery system that has a split in the rack between cell 12 and 13:

Sensor #	Cell #	Interconnection	Int. Type
1	1	charger cable - cell 1	Cable
2	2	cell 1 - cell 2	Strap
3	3	cell 2 - cell 3	Strap
4	4	cell 3 - cell 4	Strap
5	5	cell 4 - cell 5	Strap
6	6	cell 5 - cell 6	Strap
7	7	cell 6 - cell 7	Strap
8	8	cell 7 - cell 8	Strap
9	9	cell 8 - cell 9	Strap
10	10	cell 9 - cell 10	Strap
11	11	cell 10 - cell 11	Strap
12	12	cell 11 - cell 12	Strap
13	13	cell 12 - cell 13	Intertier
14	14	cell 13 - cell 14	Strap
15	15	cell 14 - cell 15	Strap
16	16	cell 15 - cell 16	Strap
17	17	cell 16 - cell 17	Strap
18	18	cell 17 - cell 18	Strap
19	19	cell 18 - cell 19	Strap
20	20	cell 19 - cell 20	Strap
21	21	cell 20 - cell 21	Strap
22	22	cell 21 - cell 22	Strap
23	23	cell 22 - cell 23	Strap
24	24	cell 23 - cell 24	Strap

Sensor #	Cell #	Interconnection	Int. Type
25*	n/a	cell 24 - charger cable	Cable

Note: Sensor #25 is the +1 sensor which is covered in the next section 6.2.

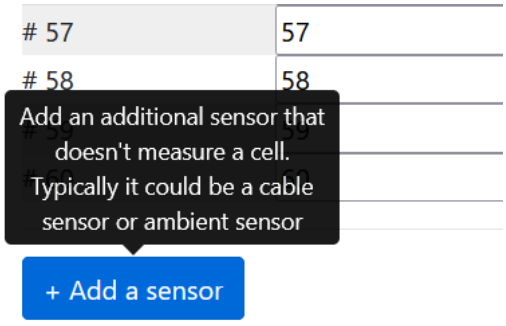
After configuration of all the above steps, the page should look something like this:



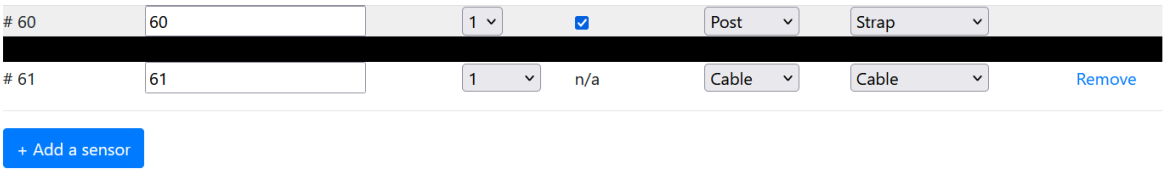
6.2 +1 Sensor

After all the standard sensors are configured the +1 sensor needs to be added. The purpose of the +1 sensor is to measure the last connection resistance between the charger cable and the negative post.

1. Scroll to the bottom of the page and click the **+ Add a sensor** button.

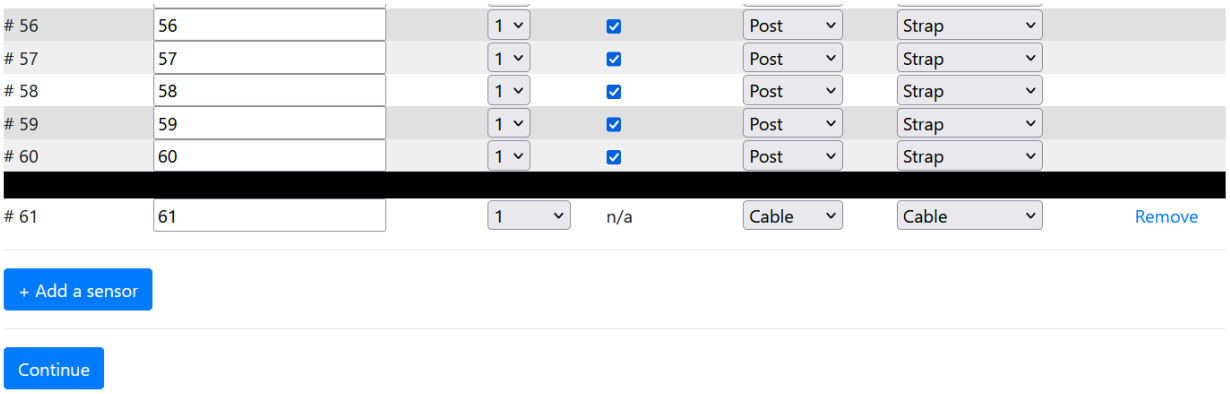


2. A new row will be added for the +1 sensor.



3. Configure the sensor as follows:
    - Select the string the sensor will be added to. For single strings, select "1" (most common).
    - Select "Cable" for the temperature column.
    - Select "Cable" for the +VE cell connection column.

The +1 sensor will now be configured. The bottom of the sensor list should look something like this:

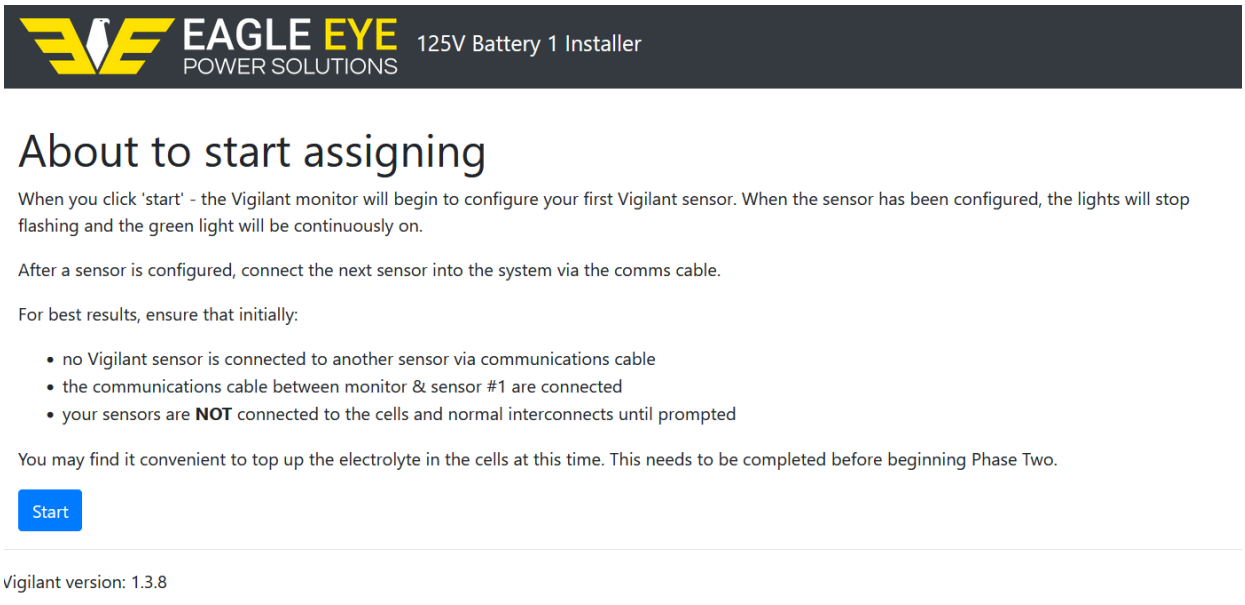


7.0 Assign Sensor IDs

Now that the sensors are configured, the next step is to assign them IDs so that they correspond to the ID number ("Install Order" column) on the previous page. Once assigned, sensors will pass through various calibrations before the system is ready to start up.

7.1 Sensor Assignment Preparation

Before assignment starts, follow these steps to ensure the system is ready.



1. Make sure only sensor #1 is connected to the monitor. If you look at the monitor, only a single RJ12 cable should be connected which is the cable that will connect to sensor 1.
2. The RJ12 cable between sensor 1 and 2 is disconnected *(as shown below in blue)*.
3. Each RJ12 cable between sensors thereafter are disconnected *(as shown below in blue)*.
4. The gray IDC connector is unplugged from the sensor. It is OK for the black IDC to be plugged into the sensor and connected to the battery *(as shown below in green)*.
    - ***Warning**: While it's okay for the black IDC to be connected to the sensor, never leave just the gray IDC plugged into a sensor. This can damage the sensor.*

After confirming these steps, click the **Start** button.

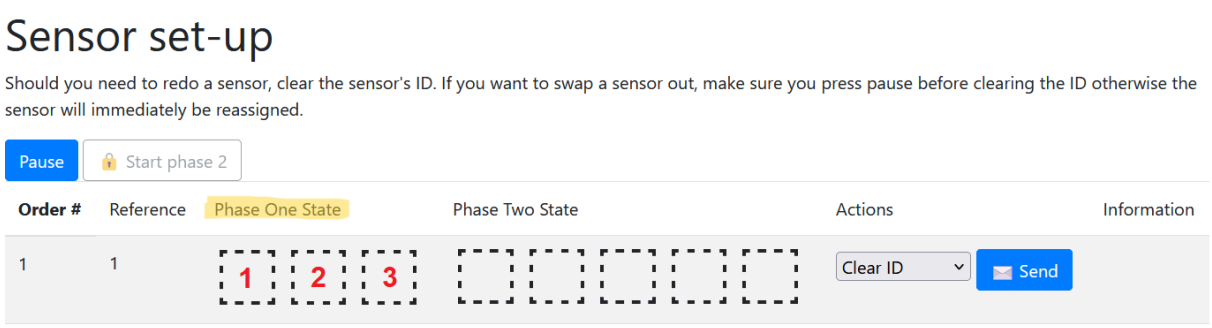
7.2 Assign Sensors

Warning: As mentioned above, the negative (black sleeved) cables must be connected before the positive (grey sleeved). Always keep this in mind when working with the sensors.

When the sensor assignment page loads, there will be 6 columns of information displayed for each sensor. This section covers the "Phase One State" column which has tasks per sensor, represented as empty boxes.

Phase One State Tasks:

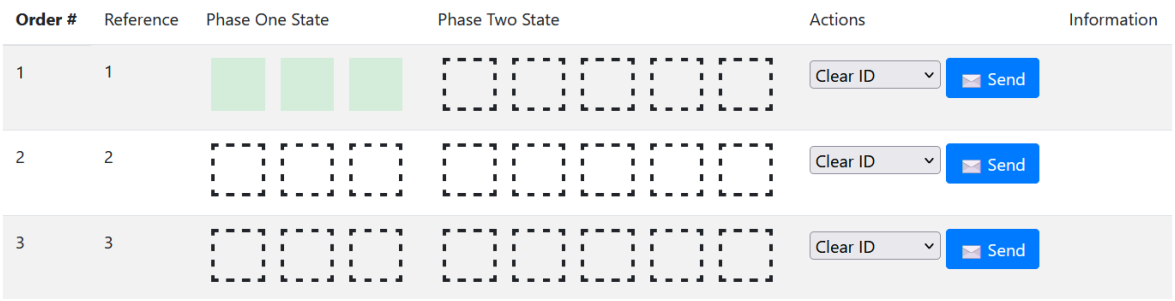
1. **ID Assignment**: Assigns the sensor an ID which is based on the order it's plugged in. The first sensor connected is assigned 1, followed by 2 and so on.
2. **Sensor Compatibility**: Determines that the VIGILANT sensor firmware version is compatible with the monitor.
3. **ELM Configuration**: Activates the ELM sensor and establishes communication. This box will be grayed out if no ELM is connected.



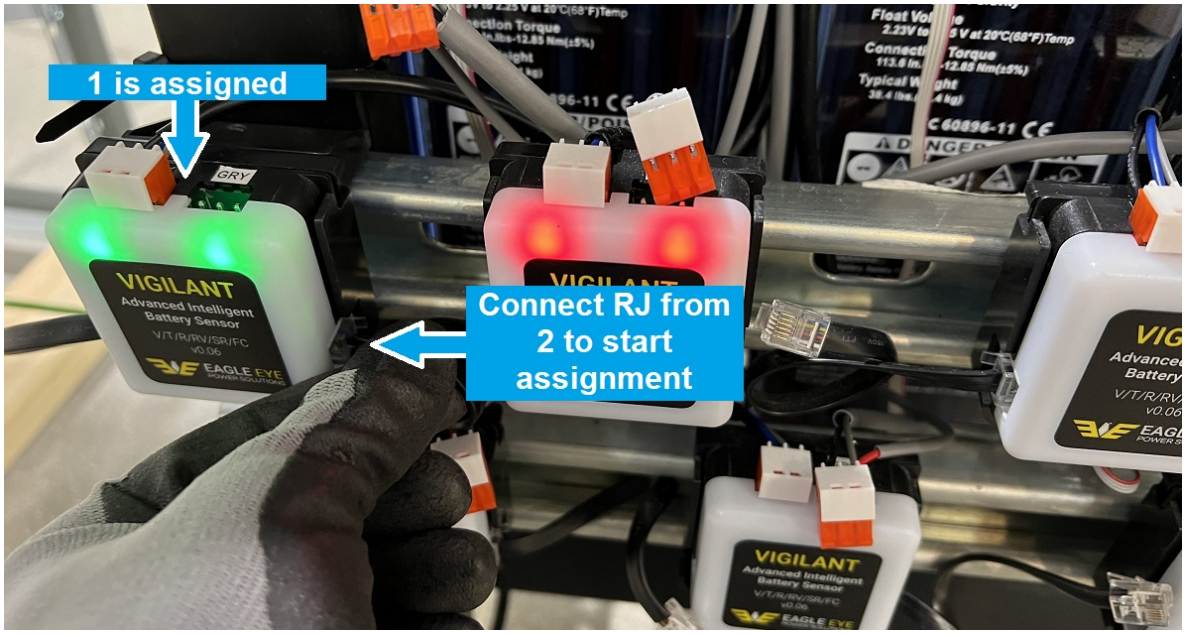
7.2.1 Connect Sensors

Preparation

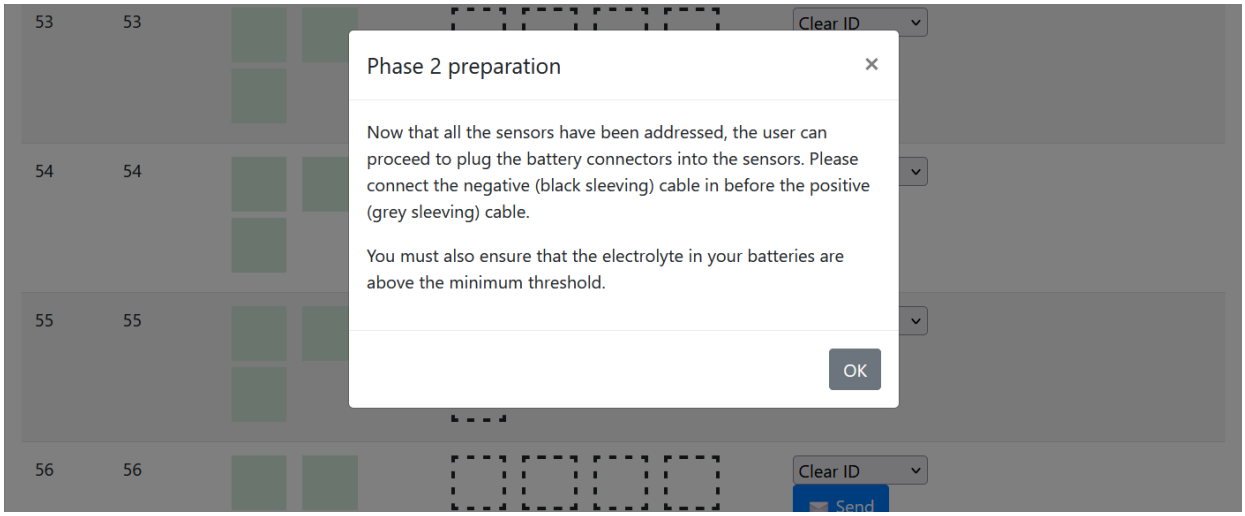
1. At the battery, connect the first RJ12 cable from the monitor to the sensor 1.
2. When connected, the first 2 boxes under Phase One State should turn green within seconds. If an ELM sensor is connected.
3. Wait until all the boxes are green and the sensor LED is a solid green. This confirms the sensor has been assigned and is ready for the next sensor.
    - ***Warning**: Plugging in sensors too soon could result in duplicate IDs being assigned. If this has occurred, or if progress is stuck on a sensor, try selecting the **Clear ID** command and click the **Send** button.*



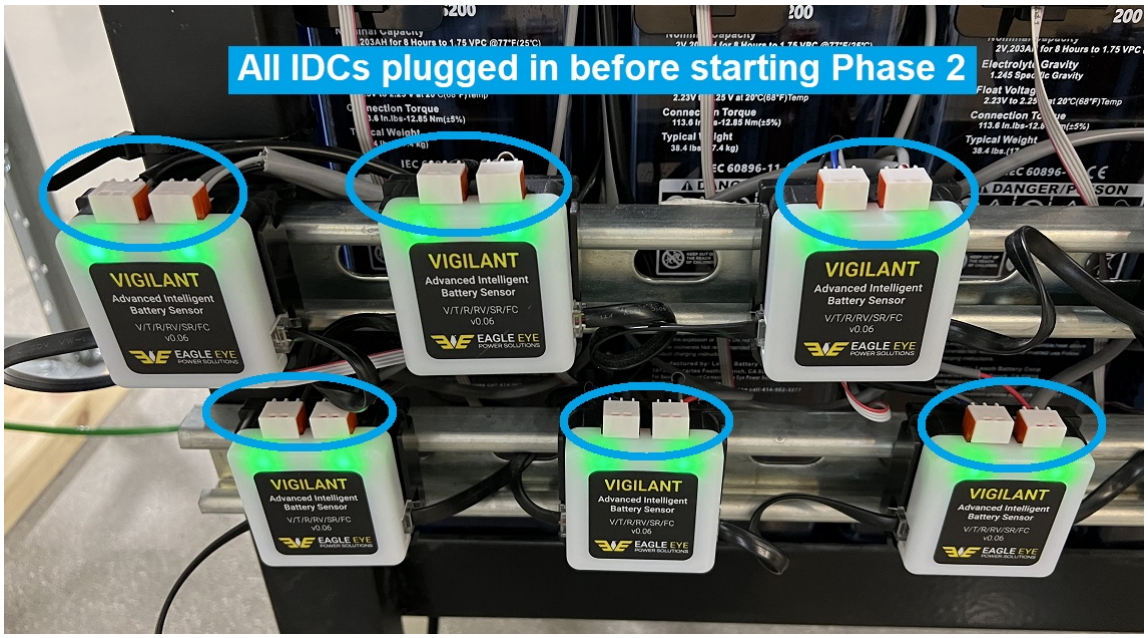
4. Proceed in connecting each sensor in order one by one until the last sensor has been assigned. The LEDs on all sensors should be solid green.



5. If all was successful, a message will appear on the screen saying the system is ready for Phase 2.



6. Before clicking the OK button to start Phase 2, ensure the following:
    - All IDC connections are plugged into every sensor like shown below. **NOTE: The black sleeved harness (left IDC) must be plugged into the sensor first, followed by the gray sleeved harness (right IDC). Failure to do so can result in sensor damage.**
    - If using ELM sensors that every cell electrolyte level is topped off.



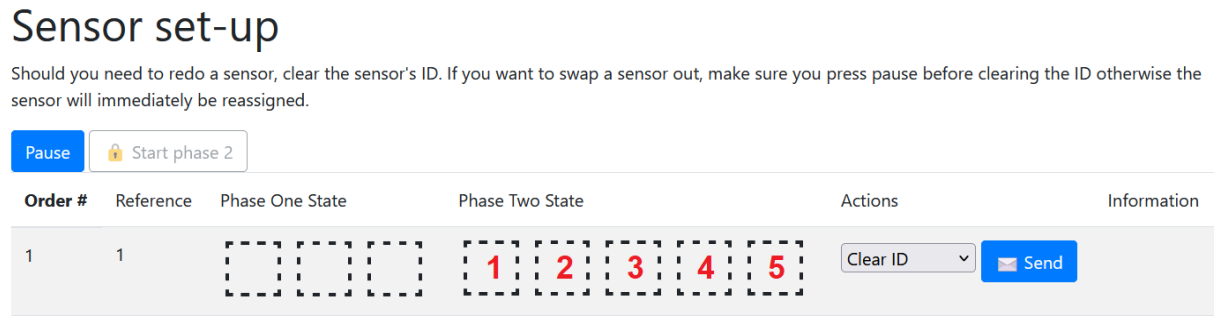
8.0 Phase 2 Calibrations

Assuming the installation of the harnesses was completed correctly, Phase 2 should involve few steps. This section covers the Phase Two State column which includes 5 tasks per sensor, represented again as empty boxes.

Phase Two State Tasks:

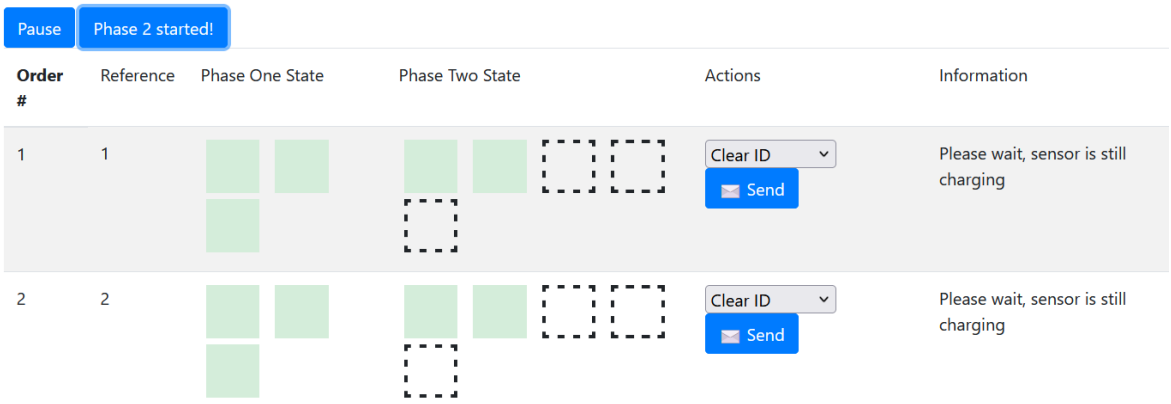
1. **Connection Check:** Verifies that some readings (unit voltage, temperature, & strap voltage) fall within acceptable bounds.
2. **Sensor Configuration:** Configures the sensor based on the provided settings.

3. **Pre-Pulse Checks:** Confirms if the sensor is ready to carry out the pulse configuration.
4. **Pulse Configuration:** Investigates, performs, and stores the battery & interconnect resistance information for the battery.
5. **ELM Calibration:** Calibrates the ELM sensor the battery (electrolyte level must be above the minimum line to pass)



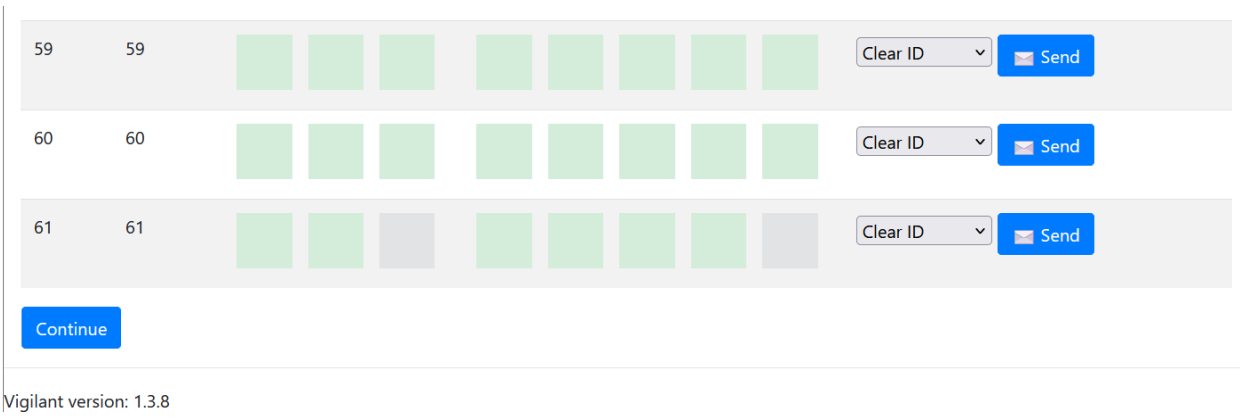
As Phase 2 starts, the execution of all tasks will carry out automatically. As there are no specific steps in this phase, below are some common errors that can occur and how to resolve them and complete Phase 2:

1. **Please wait, sensor is still charging**: This occurs when phase 2 is started too soon after connecting the IDCs to the sensors. Wait 15 minutes and restart the phase.

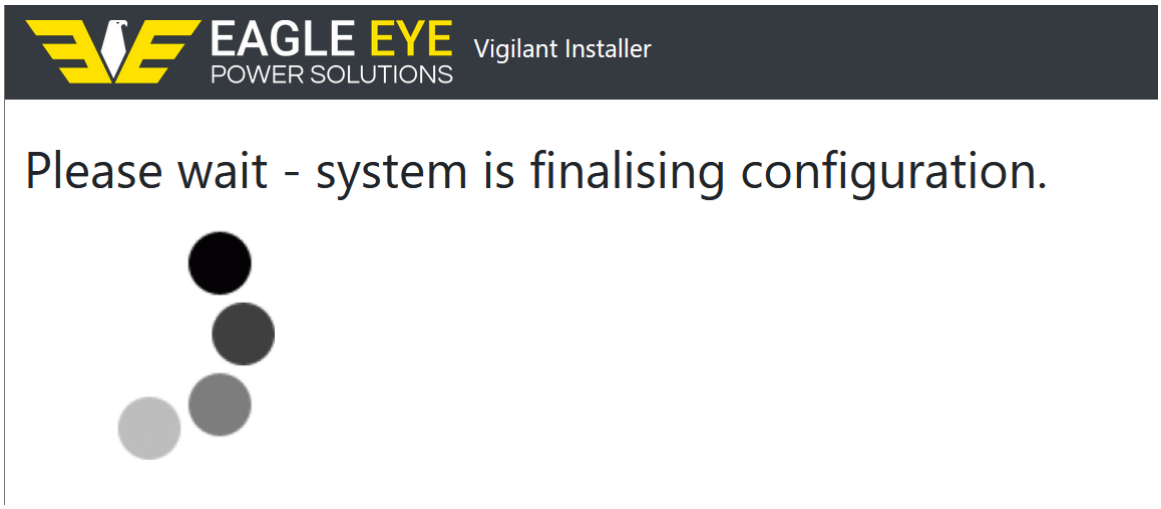


2. **Could not reset ELS:** This can occur randomly. It's best to wait as it will usually resolve on it's own. If it continues, confirm the ELM sensor is plugged in and powered on.

Once Phase 2 is completed, click the **Continue** button to complete the setup.



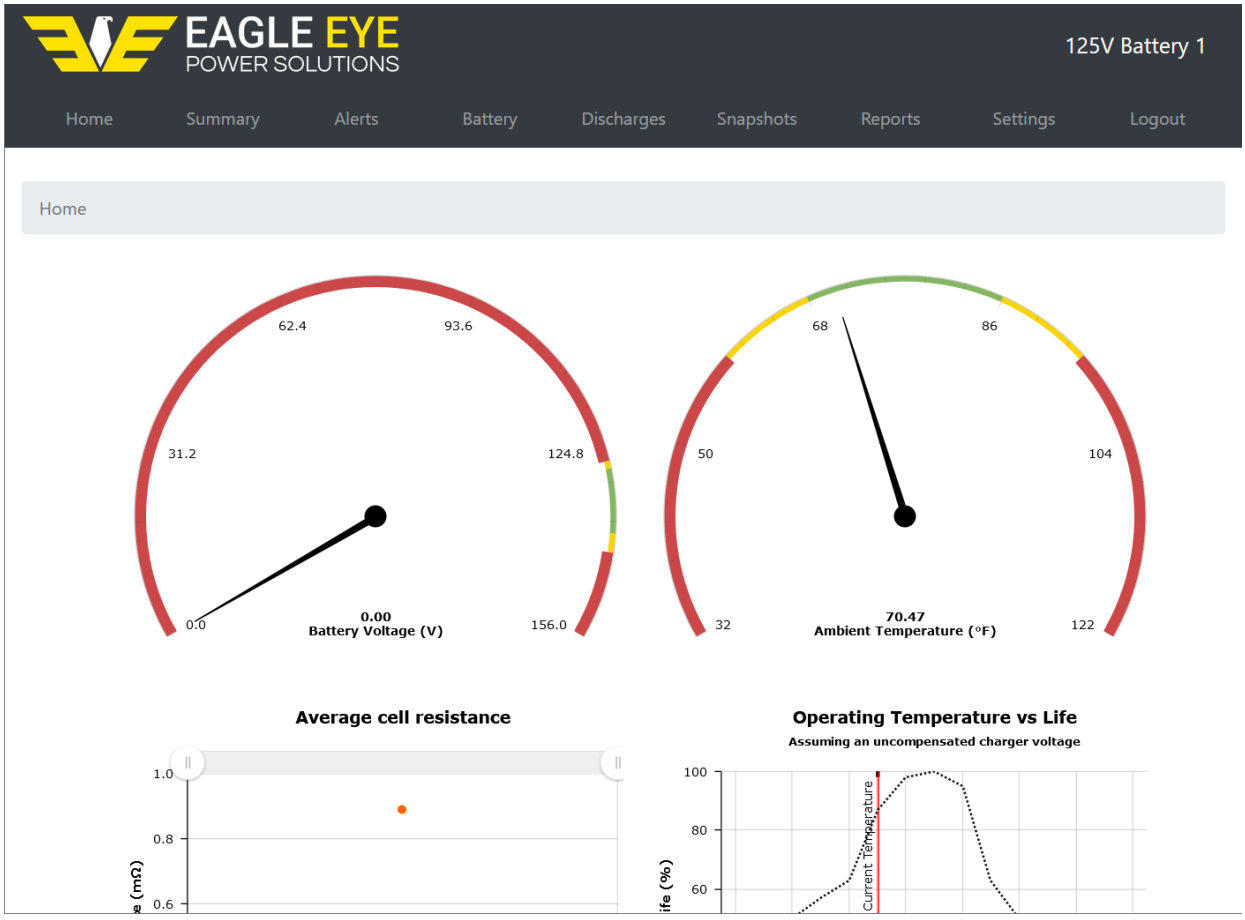
The system will finalize the setup which can take 5-15 minutes. Once completed the system **Home** page will appear.



9.0 Check Measurement Data

This section will cover how to verify measurement data on the system before generating the report. For a complete walkthrough of the web-interface features, refer to the Web-Interface User Guide.

When the system first loads the **Home** page, the float voltage reading will report back at 0V. It takes 15 minutes for the first float voltage reading to appear.



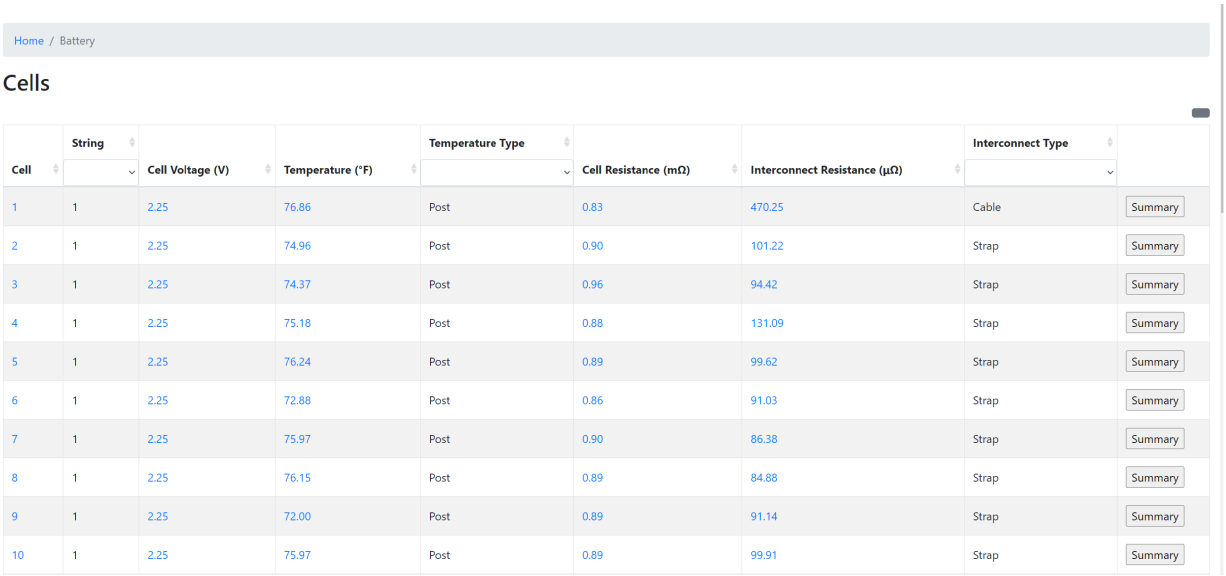
Once the voltage populates, verify the measurement data displayed on the **Home** page.

- **Float voltage:** Confirm the float voltage reading displayed is within 1% of a manual measurement with a calibrated meter.

- **Ambient temperature:** Confirm the ambient temperature seems accurate within a few degrees of what the room is at.

Next, verify the cell measurements by opening the **Battery** page.

- **Cell voltage:** Compare against portable tester, should be within 1%.
- **Negative post temperature:** Use best judgement, if a reading seems irregular investigate the surroundings for heating or cooling sources. Verify with another device if concerned.
- **Cell resistance:** Compare against portable tester.*
- **Interconnection resistance**: Compare against portable tester.*

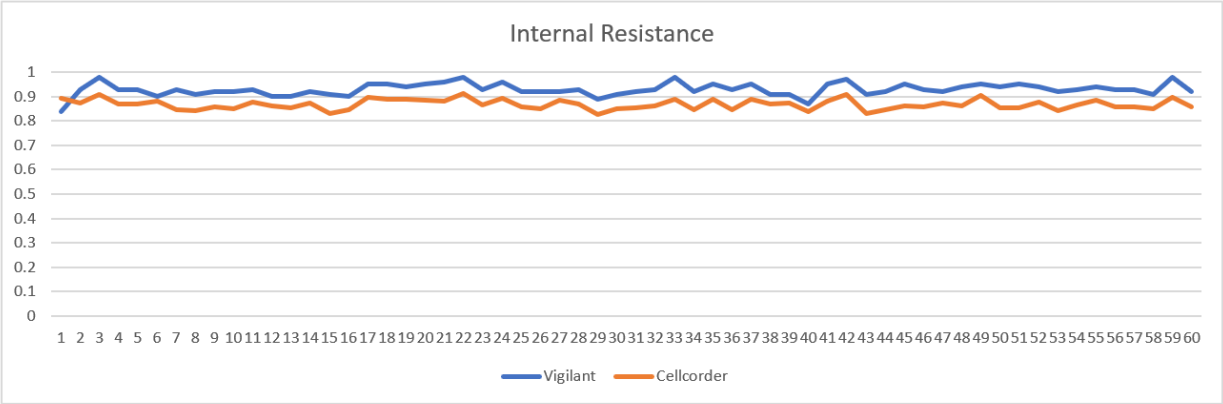


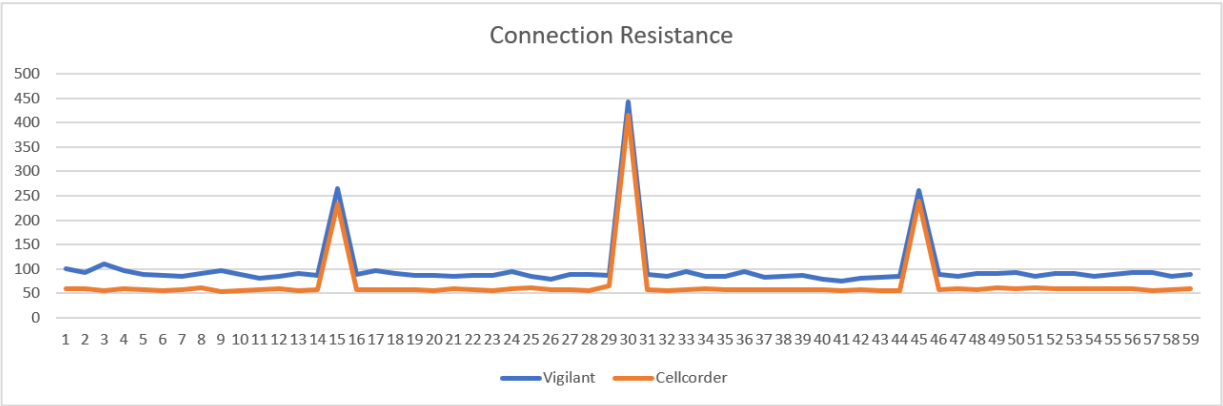
Home / Battery

Cells

Cell	String	Cell Voltage (V)	Temperature (°F)	Temperature Type	Cell Resistance (mΩ)	Interconnect Resistance (µΩ)	Interconnect Type	
1	1	2.25	76.86	Post	0.83	470.25	Cable	Summary
2	1	2.25	74.96	Post	0.90	101.22	Strap	Summary
3	1	2.25	74.37	Post	0.96	94.42	Strap	Summary
4	1	2.25	75.18	Post	0.88	131.09	Strap	Summary
5	1	2.25	76.24	Post	0.89	99.62	Strap	Summary
6	1	2.25	72.88	Post	0.86	91.03	Strap	Summary
7	1	2.25	75.97	Post	0.90	86.38	Strap	Summary
8	1	2.25	76.15	Post	0.89	84.88	Strap	Summary
9	1	2.25	72.00	Post	0.89	91.14	Strap	Summary
10	1	2.25	75.97	Post	0.89	99.91	Strap	Summary

***Note:** For resistance readings, it's recommended to export the data into Excel and plot it on a chart. Then import the data from the portable tester. Since resistance readings can vary between testers, the data may not always be the same. However, for most testers it should follow the same pattern when charted. See below example.





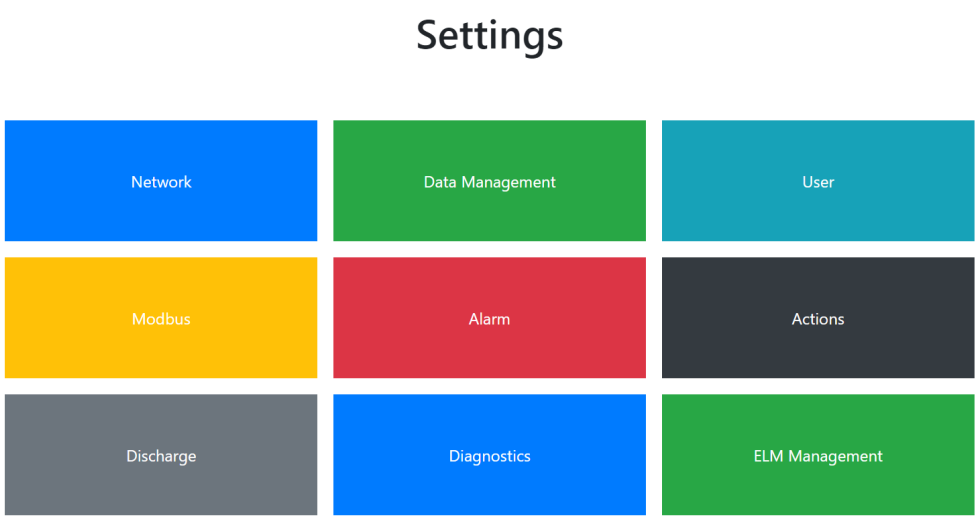
Once all the data is verified, it's time to set alarm limits.

10.0 Set Alarm Limits

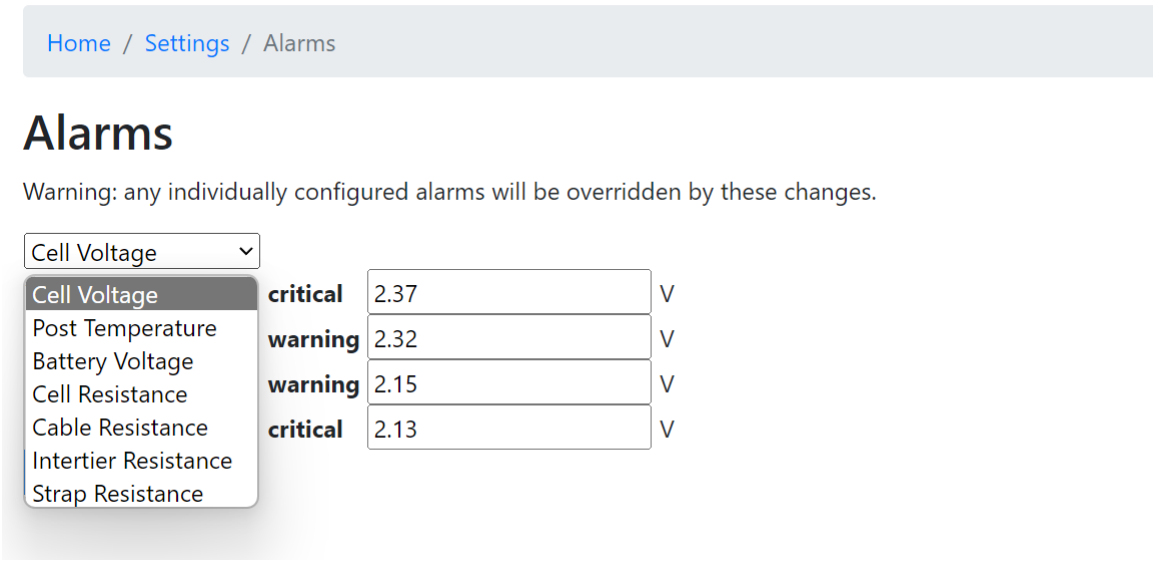
All Vigilant alarm limits should be based either on the battery manufacturers voltage limits for the cell type being monitored or a percentage change on a baseline value for the parameter that is established by the installer once the monitor has been correctly set up and commissioned.

NOTE: It is the installers responsibility to set the alarms to the best of their knowledge. Please read the below section thoroughly to understand how to set the various alarm limits. Leaving alarm limits set by default can cause false alarms which can lead to return site visits.

To adjust alarms, go to the **Settings** page, then click the **Alarms** button.



To adjust alarms, click the dropdown menu and go through each of the following parameters to set the Upper Critical, Upper Warning, Lower Warning, and Lower Critical Parameters. Note that only the critical limits will trigger the monitor LED and Relay 1.



10.1 Voltage & Temperature Alarms

The following alarms can generally be determined based on battery manufacturer spec sheets and the environmental conditions of the battery room.

1. **Cell voltage:** The upper and lower limits should be based on the battery manufacturers specified limits for that cell or unit based on the specific gravity of the electrolyte. The warning limits are typically set 5% above or below the limits alarm settings.
2. **Battery voltage:** The battery voltage limits are established by multiplying the cell voltage alarm settings by the number of cells in the battery.
    - **NOTE:** In extreme environmental conditions if the charger is set up to carry out temperature compensation it may be necessary to apply the same compensation to the alarm settings to prevent false alarms.
3. **Post temperature**: The post (cell) temperature is affected by both the ambient temperature and the electro chemical reaction in the battery. The location and layout of the battery can also affect the individual temperatures, so the typical alarm setting is a 5% rise in cell or unit temperature either based on the ambient or the average of the all the cell temperatures.
    - **NOTE:** If in an environment without temperature controls, the limits may need to be set much wider. For example, an outdoor cabinet in a temperate climate.

10.2 Ohmic Alarms

The ohmic alarms refer to internal battery and connection resistances. These require more thought to establish limits for.

1. **Internal Battery Resistance:** The ohmic value of the cell is based on the measurement of the internal resistance of the cell or unit. The Vigilant uses a DC pulse through the battery to calculate the value.

11.0 Generate NERC Report

The NERC report is simple to export, follow the steps below.

1. Click the Report tab on the web-interface.
2. Click the **NERC report**.
    - The **Monitor report** has all the same data as the NERC report but does not include any specific NERC requirements for Pass or Fail.
3. Review the report to doublecheck that all the data is good.
4. Click on either **docx** or **PDF** to export the report to the desired format.

11.1 Understanding the Report

1. **Metadata:** Includes general information about the battery including the name, make, model, nominal ratings, etc.

Vigilant NERC Report

Metadata

Battery Name	125V Battery 1
Model	Example Model
Manufacturer	Example Manufacturer
Nominal Voltage	2.0 V
Nominal Capacity	200.0 Ahr
Battery Manufactured Date	2019-06-01
Battery Install Date	2019-09-01
Report Generated	2023-06-30 14:18:30
System Type	Vigilant BMS
System Version	1.3.11-e5e743ff433a071212f8e04fcb2da30d85835165
Ambient Temperature	76.3 (°F)
Average Post Temperature	75.17 (°F)
Report Version	1.5

2. **Stations DC Supply PRC-005-6 Compliance Summary**: Includes Pass or Fail status for all parameters that are required to be monitored and alarmed against in Table 1-4(f) of the PRC:
    - Battery float voltage
    - Station DC supply
    - Ground fault status
    - Cell voltage
    - Cell resistance
    - Interconnection resistance
    - Electrolyte level

Station DC Supply PRC-005-6 Compliance Summary

Battery Float Voltage / Station DC Supply	Pass	Cell Voltage	Pass
Battery Continuity	Pass	Cell Resistance	Pass
Post Temperature	Pass	Interconnection Resistance	Pass
Ground Fault	Pass	Electrolyte Level	Fail

3. **Station DC Supply TPL-001-5 Compliance Summary:** Includes Pass or Fail status for parameters monitored and alarmed against to meet TPL compliance:
    - Battery continuity
    - Station DC supply

Station DC Supply TPL-001-5 Compliance Summary

Battery Continuity	Pass	Station DC Supply	Pass

4. **Summary Data:** Includes battery voltage, current, ambient temperature, and ground fault status.

Summary Data

Battery Voltage (V)	Battery Current (A)	Ambient Temp (°F)	Ground Fault
135.47	-0.07	76.3	Pass

5. **Cable & Intertier Data:** Includes any interconnection readings designated as a cable or intertier. This is to not affect the average of the strap values from the next table.

Cable & Intertier Data

ID	Interconnection Type	Resistance (μΩ)
1	Cable	470.25
16	Intertier	451.48
31	Intertier	448.31
46	Intertier	260.18
61	Cable	4524.62

6. **Battery & Strap Data:** Similar to the Battery page, it includes the readings for each cell voltage, resistance, temperature, and strap resistance.

Battery & Strap Data

Min	2.23 (Cell 45)	0.83 (Cell 1)	71.96 (Cell 21)	74.75 (Cell 42)
Average	2.25	0.89	75.17	90.02
Max	2.26 (Cell 42)	0.96 (Cell 3)	79.38 (Cell 41)	131.09 (Cell 4)
Cell ID	Cell Voltage (V)	Cell Resistance (mΩ)	Post Temperature (°F)	Strap Resistance (μΩ)
1	2.25	0.83	77.00	cable connection
2	2.25	0.90	75.14	101.22
3	2.25	0.96	74.52	94.42
4	2.25	0.88	75.33	131.09
5	2.25	0.89	76.42	99.62
6	2.25	0.86	73.04	91.03
7	2.25	0.90	76.16	86.38
8	2.25	0.89	76.36	84.88
9	2.25	0.89	72.22	91.14
10	2.25	0.89	76.11	99.91
11	2.25	0.88	76.30	92.31
12	2.25	0.87	72.37	83.34
13	2.25	0.86	73.17	85.88
14	2.25	0.87	72.18	91.67
15	2.25	0.88	77.01	88.33
16	2.25	0.87	73.15	intertier connection
17	2.25	0.90	76.37	90.12
18	2.25	0.92	76.42	98.48
19	2.25	0.91	72.50	92.89
20	2.25	0.91	73.20	87.23