UHPC Knowledgebase Manual

www.avrionlabs.com

Table of Contents

1. Hardware

This section covers hardware operations, maintenance, and troubleshooting for the UHPC system, including the Controller Module, Channel Module, Cell Holders, Thermal Chambers, and interconnect cables.

1.1 How to Power Cycle UHPC Hardware

1. How to Power Cycle UHPC Hardware Here is how to properly Power cycle your UHPC Controller Module and UHPC Channel Module. See guide on "How to Stop and Resume Tests". It explains how to safely interrupt connections without disrupting your tests. 1. Close the UHPC Control Software. 2. Turn off the power switch on the Controller Module (located on the rear). 3. Turn off the power switch on the affected UHPC Channel Module (located on the rear). 4. Turn the Controller Module back on. 5. Wait 60 seconds, then turn the UHPC Channel Module back on. 6. Open the UHPC Control Software. Refer 'How to Troubleshoot Ethernet Connections' guide if a connection isn't established.

> ⚠ **Alert:** Do not Power Cycle your UHPC Channel Module or Controller while tests are in progress.

1.2 How to Reset UHPC Hardware

1. How to Reset UHPC Hardware A Reset can fix common issues. Here is how to properly reset your UHPC Controller Module and UHPC Channel Module. Reset your Controller Module and UHPC Channel Module.
2. Begin by closing the UHPC Control Software
3. Press the Reset button on the Controller Module.
4. Wait for 30 seconds after pressing the Controller Reset button.
5. Press the Reset button on the affected UHPC Channel Module.
6. Open the UHPC Control software on your PC. Refer 'How to Troubleshoot Ethernet Connections' guide if a connection isn't established.

> ⚠ **Alert:** Do not reset your UHPC Channel Module or Controller while tests are in progress.

1.3 How to Troubleshoot Ethernet Connections

1. UHPC Hardware- How to Troubleshoot Ethernet Connections Communication errors can be caused from faulty hardware connections. This could be displayed as Ping Not Received, Controller Connection Issue, or Bad Packet Error. It's important to isolate where the connection is being interrupted to resolve the issue. Do not reset your UHPC Channel Module or Controller while tests are in progress.
2. Check the UHPC Channel Module-Controller Module for a snug connection of the Communication Cable (Ethernet Cord) on both ends. If loose, ensure a firm fit and check if error is corrected. • If connection is snug but the error persists, swap the Communication Cable (Ethernet Cord) of the affected module, with an Ethernet Cord

that you know works well. • Reset your system. • If a connection isn't established, move to the next step.

> ⚠ **Alert:** Before disconnecting any cell holder or cable connections, ensure that no tests are running and power is OFF.

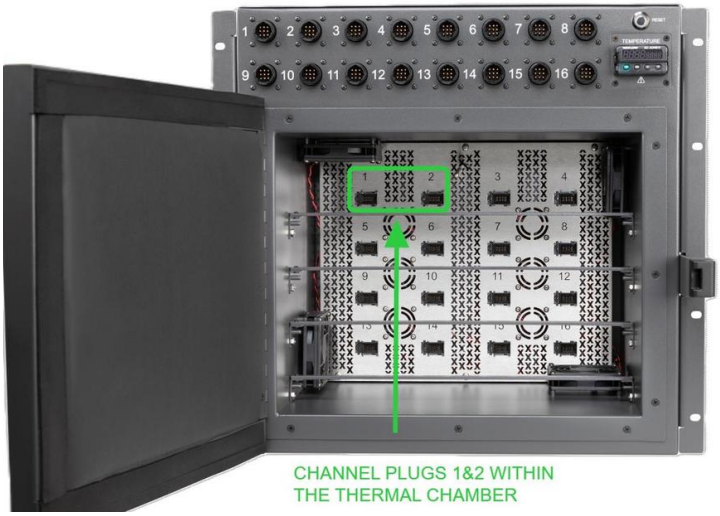
3. • If errors persist with known working Ethernet cord, try using a different Ethernet Port on the rear of the Controller Module. • For example, if the affected module was plugged into Port 1, plug its Ethernet cord into Port 2 (or any open port). • Reset your system. • If a connection isn't established, move to the next step.

> **Tip:** Refer to the "How to Reset UHPC Hardware" guide for proper completion of Reset in steps 1 and 2.

1.4 How to Troubleshoot Cell Holder Connections

1. How to Troubleshoot Cell Holder Connections If your Cell within your Cell Holder is misaligned, or your Cell Holder connection to the Thermal Chamber is loose, you will receive errors.
2. Here are the steps to troubleshoot your Cell Holder connection. • Inspect the Cell Holder and Thermal Chamber Channel plug connections. If loose, ensure a firm fit and check if error is corrected. • If connection is snug but the error persists, swap the Cell Holder in the affected Channel plug with a known working Cell Holder.
3. For example, if Channel 1 of the Thermal Chamber has an error but Channel 2 is working well, swap the Cell Holder from Channel 2 into Channel 1.
4. If the issue persists with a known working Cell Holder, it's unlikely to be caused by the Cell Holder itself.

> ⚠ **Alert:** Before disconnecting any cell holder or cable connections, ensure that no tests are running and power is OFF.

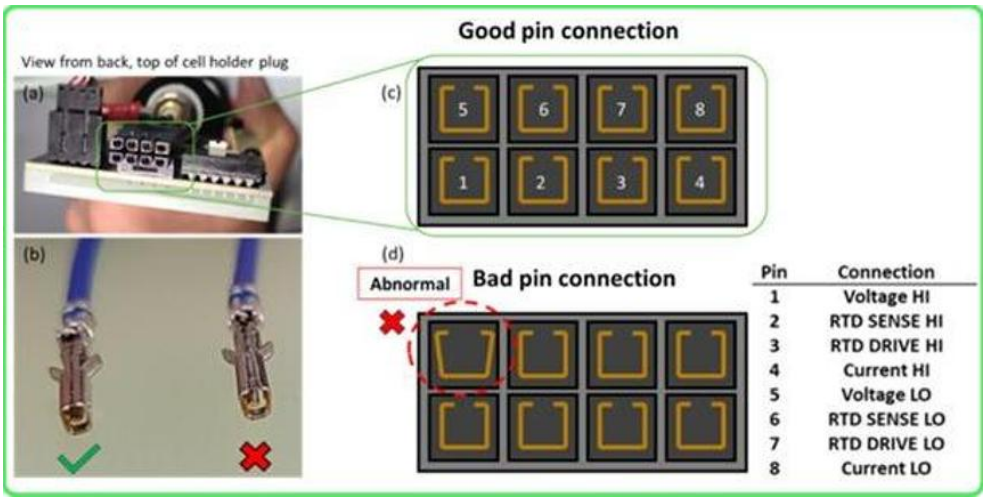


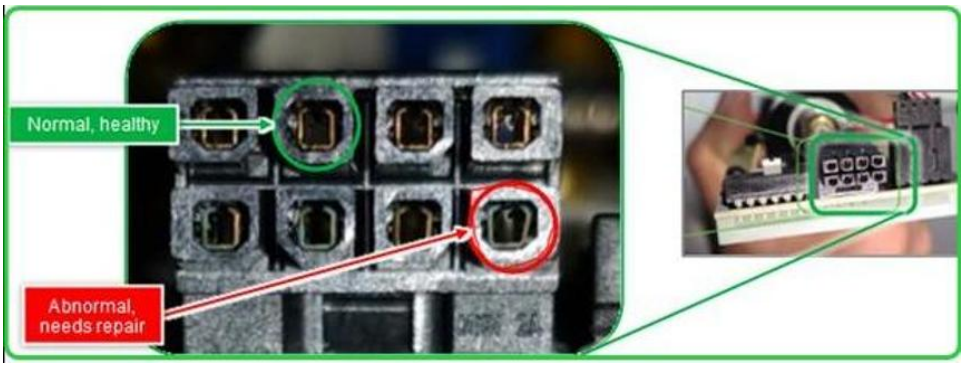
5. If a connection isn't established, see guide on 'Troubleshooting Interconnect Cable Connections.' Please see 'How to Repair Cell Holder Pin Connections' for detailed method on how to fix common issues.

> ⚠ **Alert:** If your Cell Holder is causing errors.

1.5 How to Repair Cell Holder Pin Connections

1. Cell Holders- How to repair Cell Holder Pin Connections Bad pin connections will cause errors such as: Channel Cannot Maintain Current, Channel Cannot Maintain Voltage, or Temperature Out of Range. All Cell Holder pins should be in a normal square shape. Occasionally, during routine use, some pins may be opened by the mating stresses, causing them to lose continuity. Below is another example of deformed pin connections, which would cause errors.

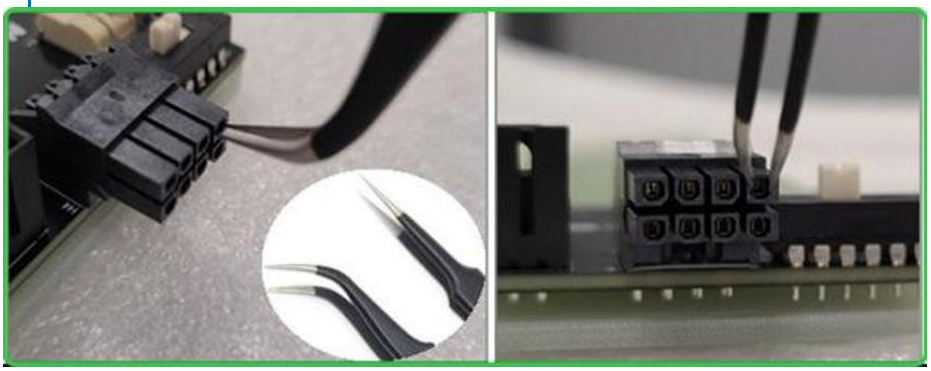




2. To fix the issue, we use fine, sharp- Insert the com if unsure about pin adjustment. If Interested in pricing of new products, please contact BTS-Sales@Novonixgroup.com

⚠ **Alert:** NOVONIX has developed Magnetic Connections for all current Cell Holders and Thermal Chambers because of this issue.

Tip: ped tweezers.



1.6 How to Troubleshoot Interconnect Cable Connections

1. How to Troubleshoot Interconnect Cable Connections Having a faulty connection between the Channel Module and the Thermal Chamber can cause communication issues. Below are the steps to troubleshoot this connection. • Check the Thermal Chamber-UHPC Channel module connection for a snug connection of the Interconnect Cable on both ends. If loose, ensure a firm fit and check if error is corrected. • If connection is snug but the error persists, swap the Interconnect Cable from the affected Channel Port-Thermal Chamber Port with a known working Interconnect Cable. • If the issue persists with a known working cable, we can conclude the interconnect cable is not the cause of the issue. Refer to 'How to Reset your UHPC Hardware' guide if connection is not established.

> ⚠ **Alert:** Before disconnecting any cell holder or cable connections, ensure that no tests are running and power is OFF.

1.7 How to Replace a WRC Relay

1. UHPC Hardware - How to Replace a WRC Relay This guide provides instructions for replacing a WRC relay, a component that can wear out due to frequent cycling between heating and cooling. By following the step-by-step process, users can efficiently and safely perform the replacement, ensuring the chamber operates optimally within the desired temperature range. When the WRC chamber is programmed to maintain a room temperature range (15–35 °C) for prolonged periods, the system frequently switches between heating and cooling. This repeated cycling causes wear on the relay component shown below.

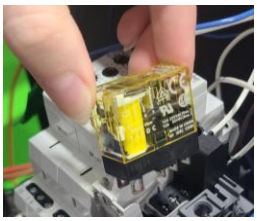
2. • Power off and unplug the chamber. • Using a Phillips screwdriver, remove the 14 flathead screws (size 8-32 x 3/8) from the top roof panel of the Wide Range Chamber.

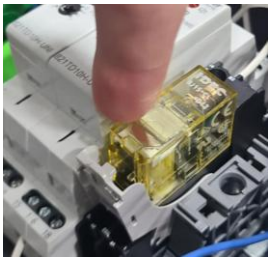
3. Once all Phillips flathead screws are removed, lift off the roof panel and place it in a safe location, lying flat.

4. • Locate the transparent yellow IDEC relay on the component shelf inside the chamber. • The gray tab on the relay base secures the IDEC relay in place.

5. Pull the gray tab back to release the IDEC relay.

6. Firmly grip the relay and pull straight up to remove it from its base. • Insert the new relay, making sure the contact tabs align with the slots in the base. • Press the relay straight down until the gray tab locks into place.



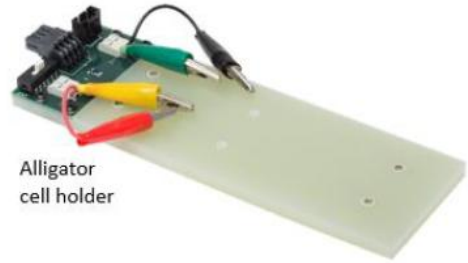


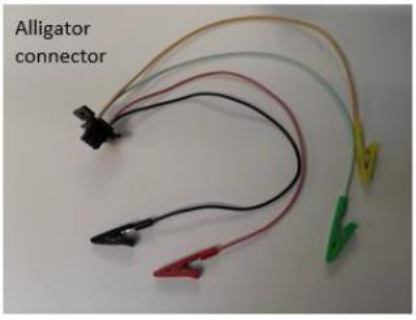
7. The replacement is now complete. • Return the roof panel and fasten the flathead screws. • It is now safe to plug in the chamber and turn the power on.

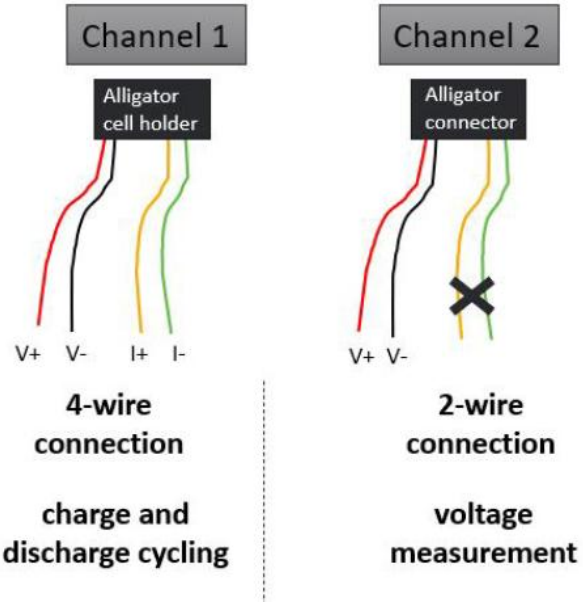
1.8 Testing a Three-Electrode Cell with UHPC

1. UHPC Hardware- Testing a Three-Electrode Cell with UHPC By following this procedure, you can effectively test a three-electrode cell using a NOVONIX UHPC system, enabling accurate measurements and deeper analysis of electrochemical behavior. Three-electrode testing is valuable for: - Understanding electrode crosstalk reactions - Identifying the contributions of individual electrodes to irreversible capacity loss during formation - Quantifying active mass loss and capacity shift loss Preparation Checklist 1. Three-electrode cell 2. Alligator pouch cell holder (Main or base channel) 3. Alligator cell holder with extended voltage leads (Auxiliary or reference channel) 4. UHPC system

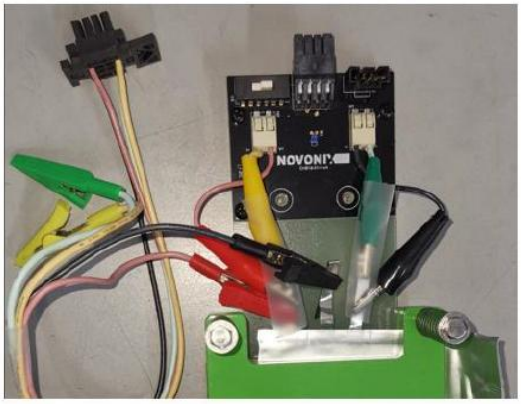
2. Procedure 1. Select Testing Channels • Determine which two channels will be used for the experiment. • Assign one as the main channel to handle charging and discharging of the full cell. • Assign the other as the auxiliary channel to monitor potential changes between the cathode and reference electrodes. • Figures below illustrate the hardware setup required to connect two channels to a single cell.

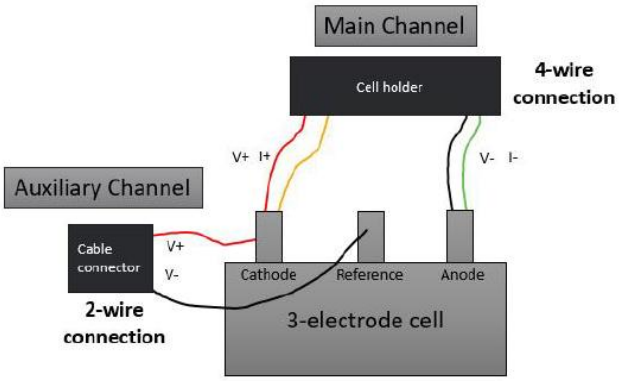




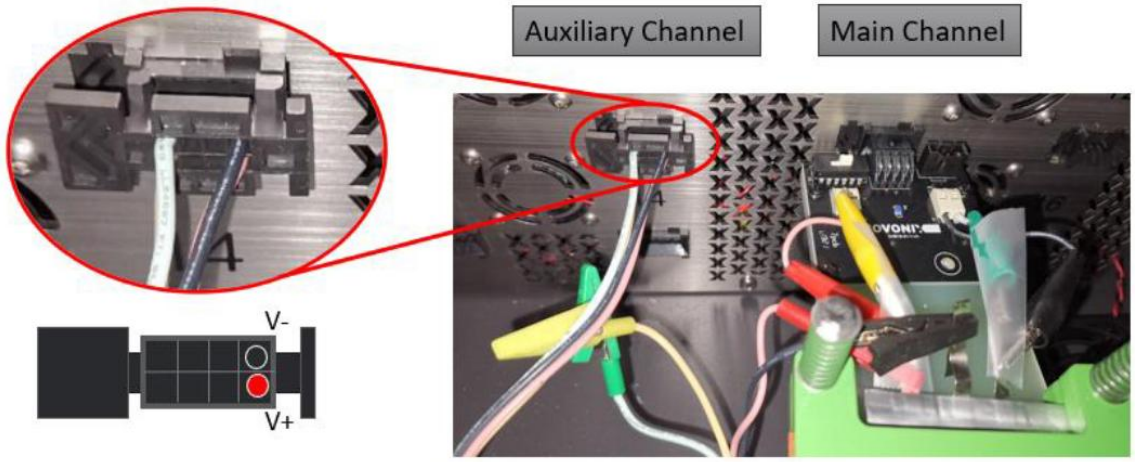


3. Procedure 1. Connect the Three-Electrode Cell • Establish all required connections to the working, reference, and counter electrodes as per the selected channel configuration. • To maintain stability during testing, connect the positive voltage lead to the cathode and the negative voltage lead to the reference electrode when using a lithium metal reference. This configuration helps ensure that the cathode–reference potential remains above 0 V throughout full cell cycling. If the voltage drops below 0 V, the electrode reference test will automatically be halted. If the anode–reference potential is desired, it can be calculated by subtracting the full cell potential from the cathode–reference potential.



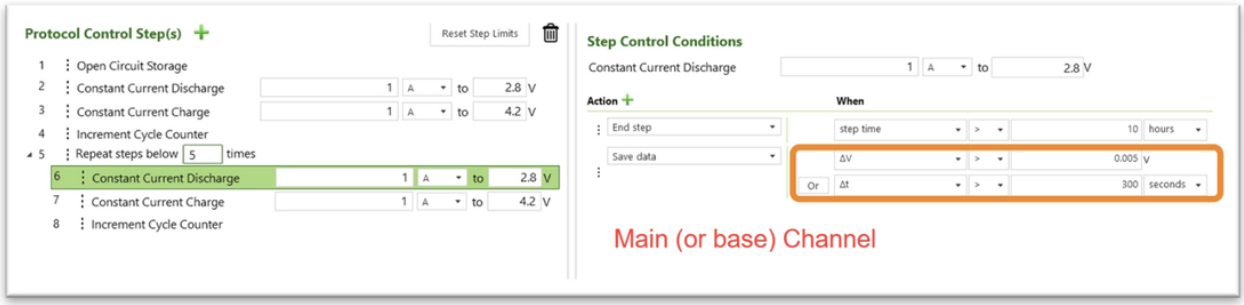


4. Connect the Cell to the Designated Testing Channels • Ensure the cable connector is properly aligned. • Confirm that the positive and negative voltage leads are correctly positioned, with the positive lead on the rightmost pin of the 8-pin connector. • Refer to Figure 3 for the correct pinout and cell connection layout.

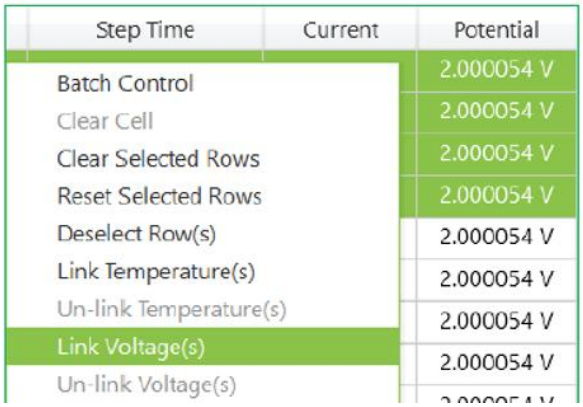


5. Develop Testing Protocols in UHPC Protocol Software Create protocols for both the main and auxiliary channels using the UHPC Protocol software: • It is assumed the user can design a protocol for the main channel to execute a full cell test, such as cycling. • For the auxiliary channel, set up an OCV (Open Circuit Voltage) step. This step will measure voltage without applying current. • Select a sampling rate that is similar to or the same as that used in the main full cell cycling test. • Set a test duration that spans the entire expected duration of the full cell test to ensure complete voltage monitoring.

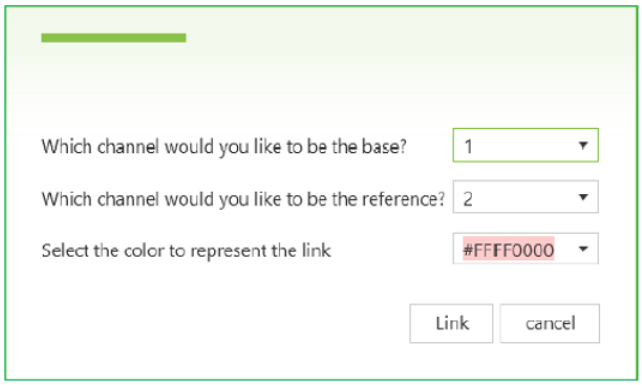
> **Tip:** If the Main or base channel's protocol uses the “ref voltage” parameter, it will monitor the reference channel’s voltage and perform step operations based on that value, rather than its own.



6. Linking Voltages Between Main (or base) and Auxiliary (or Reference) Channels in UHPC Control In UHPC Control, you can link voltages by selecting the main and auxiliary (or reference) channels, right-clicking, and choosing Link Voltage(s). This establishes a connection that allows the main channel to reference voltage data from the auxiliary channel.

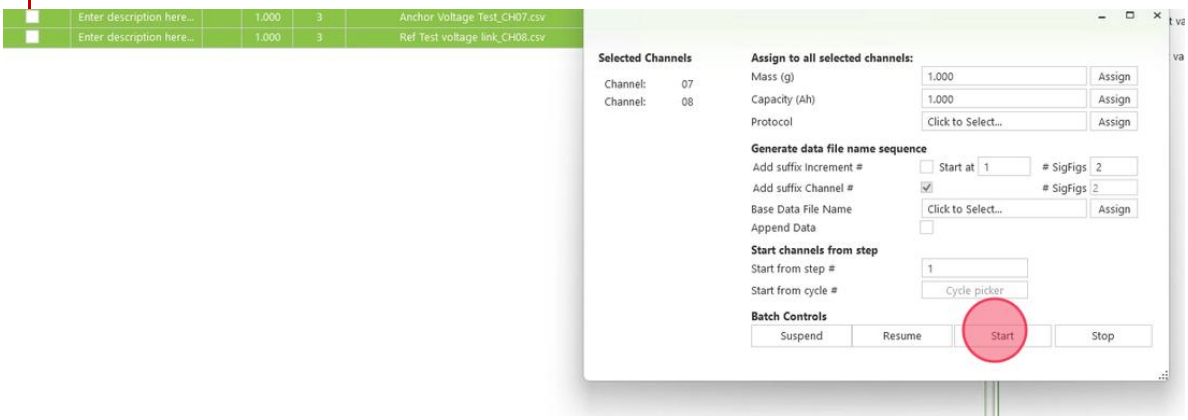


7. Linking Voltages Between Main (Base) and Auxiliary (Reference) Channels in UHPC Control In UHPC Control, when voltage channels are linked: • The base channel records its own voltage along with the voltages of linked channels. • If the base channel's protocol uses the “ref voltage” parameter, it will monitor the reference channel’s voltage and perform step operations based on that value, rather than its own.



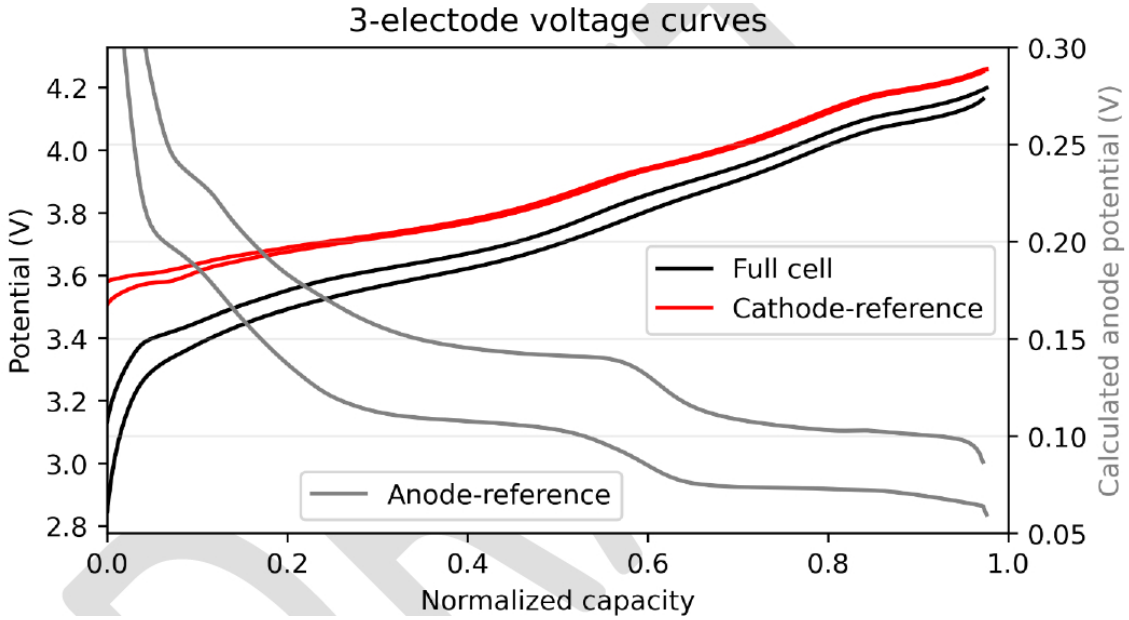
8. Start the Main and Auxiliary Channels in UHPC Control • Load the appropriate protocol on each channel. • Enter file names for both the main and auxiliary channels. • On the main channel, input any required details such as capacity, active mass, or other relevant parameters. • Once all information is entered, select both channels and use the Batch Start command to begin the test simultaneously. Attempting to import a snapshot to a linked or active channel will fail.

> ⚠ **Alert:** : Snapshots cannot be imported to channels that have existing temperature or voltage links, or to channels that are not in the Idle state.



9. Generate Plots and Analyze Testing Data • The full cell and cathode–reference potentials are directly measured and can be viewed in UHPC Plot. • The anode–reference potential can be calculated, but this analysis must currently be done outside of UHPC Plot. • Figure below displays example data from a NOVONIX UHPC system using a prototype three-electrode stacked pouch cell, including the calculated anode–reference potential. By following this procedure, you can effectively test a three-electrode cell using a NOVONIX UHPC system, enabling accurate measurements and deeper analysis of electrochemical behavior. Three-electrode testing is valuable for: • Understanding electrode crosstalk reactions • Identifying the contributions of individual electrodes to irreversible capacity loss during formation • Quantifying active mass loss and capacity shift loss While differential voltage analysis can theoretically provide this information, it is often challenging for materials that lack strong differential voltage features, such as LiFePO4, Li4Ti5O12, and hard carbon electrodes. Three-electrode

cells offer direct measurements that can reveal active mass loss and shift loss in these cases, where differential voltage analysis may fall short.



2. Software — UHPC Control

This section covers all guides related to the UHPC Control software application, including configuration, notifications, updates, system settings, and test management.

2.1 How to Install UHPC Software Updates

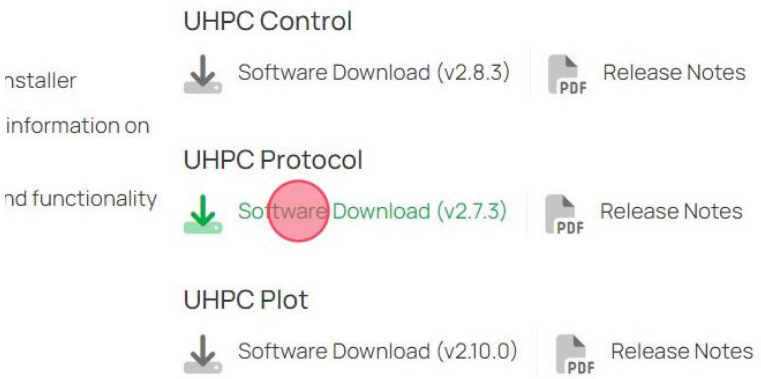
1. How to Install UHPC Software Updates Navigate to https://www.avrionlabs.com/customer-area/ Stop the test, Close UHPC Control software, Install the update, and resume your tests. Click "Software Download" Under UHPC Control.

> ⚠ **Alert:** If you currently have tests operating in UHPC Control and need to install update.

> **Tip:** Remember to close the UHPC Control Software prior to installing the update.

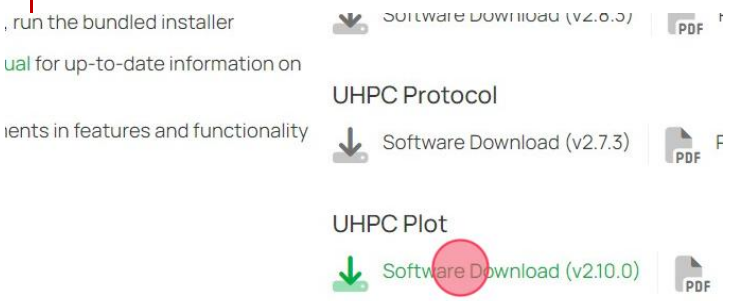
2. Enter your "Company Name" and "Email" to download Control. You do not require a password. Click "Software Download" under UHPC Protocol Enter your "Company Name" and "Email" to download Protocol. You do not require a password.

> **Tip:** Remember to close the UHPC Protocol Software prior to installing the update.



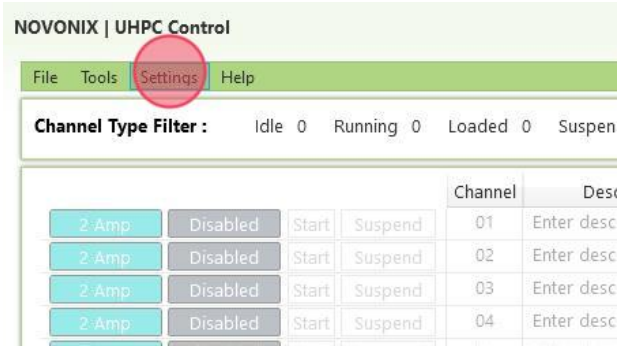
3. Click "Software Download" Under UHPC Plot Enter your "Company Name" and "Email" to download Plot. You do not require a password. 5.0 or earlier, you will need to manually uninstall the old version of software from your computer, in order for the new version to work. Any email address entered above will receive periodic updates and announcements about your UHPC equipment and software.

⚠ **Alert:** If you are updating from version 2.

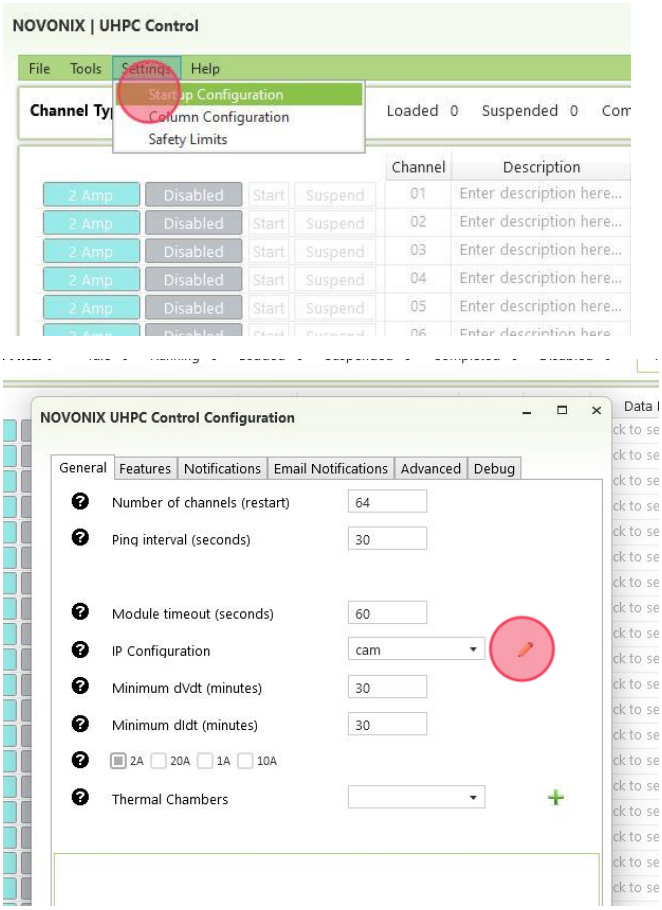


2.2 How to Change System Name

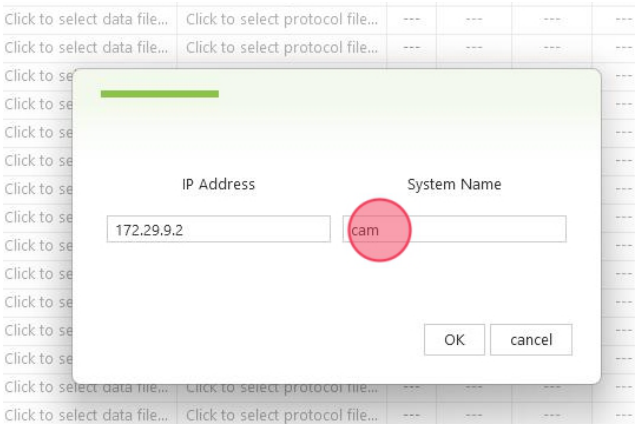
1. UHPC Control- How to Change System Name This guide provides a process for changing the system name in UHPC Control, ensuring users can easily personalize their setup and receive accurate Email Notifications from their UHPC equipment. Open UHPC Control and click "Settings"

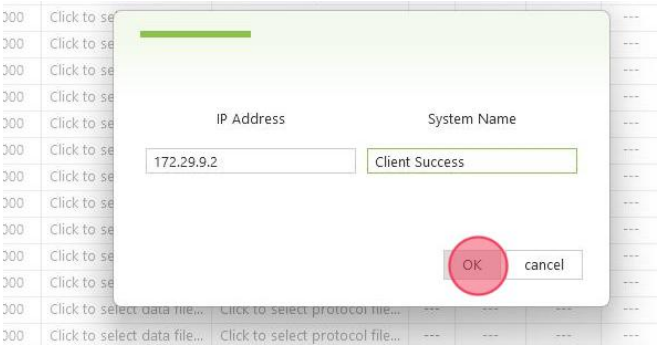


2. Click "Startup Configuration" Click the "pencil icon" to open up IP Configuration and System name.

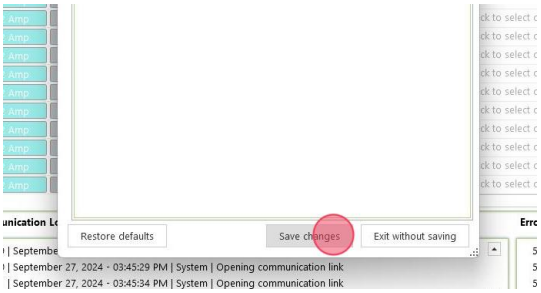


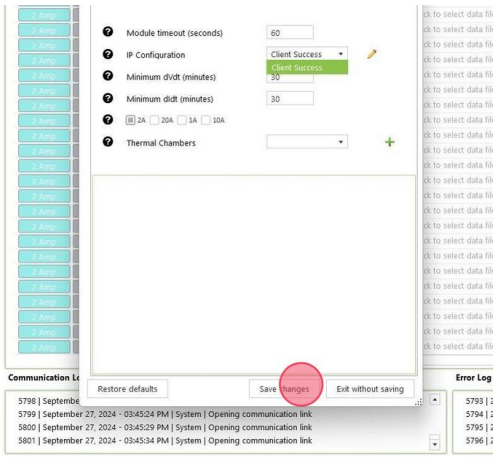
3. Click the system name text box Change your system name and click "OK"



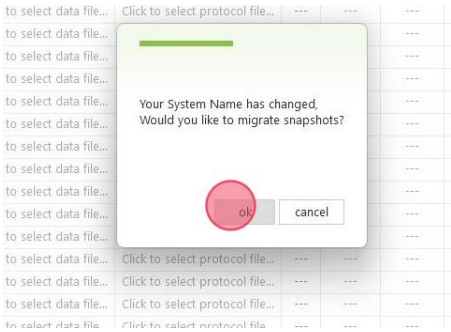


4. Click "Save changes" Click "Save changes"



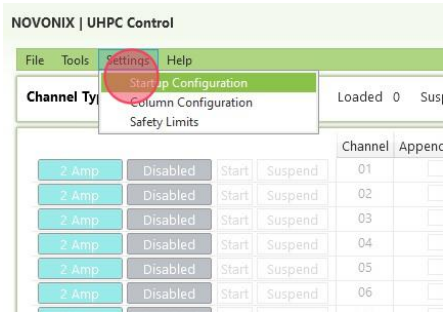


5. Click "ok"

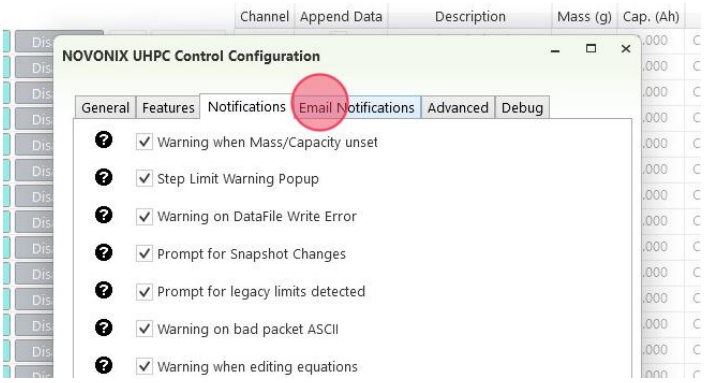


2.3 How to Configure Email Notifications

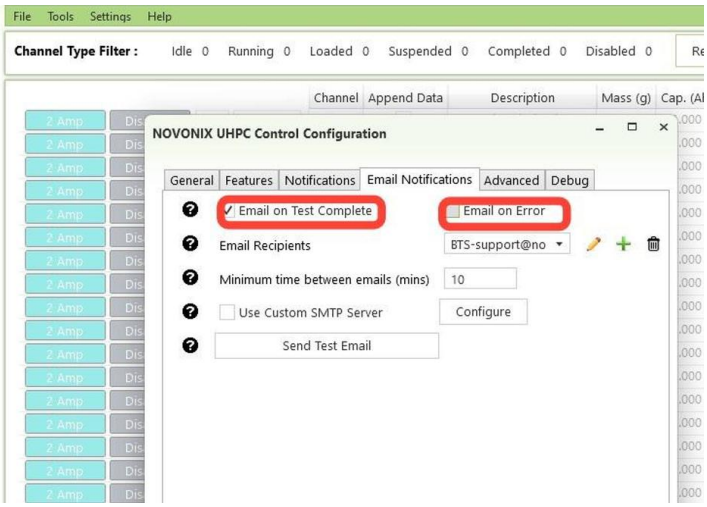
1. Configure Email Notifications Settings in UHPC Control Software Click "Startup Configuration"



2. Click "Email Notifications" tab

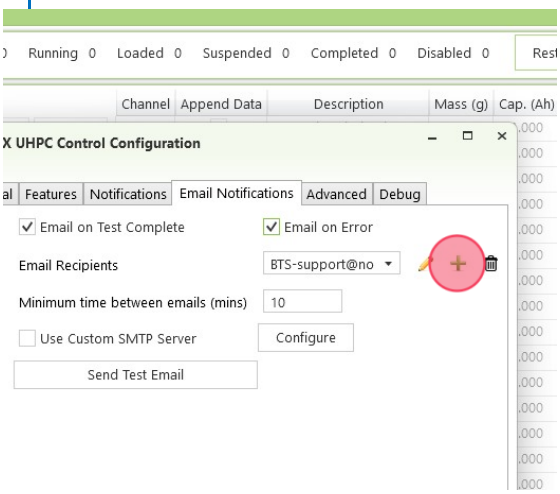


3. Click on "Email on Error" and/or "Email on Test Complete"



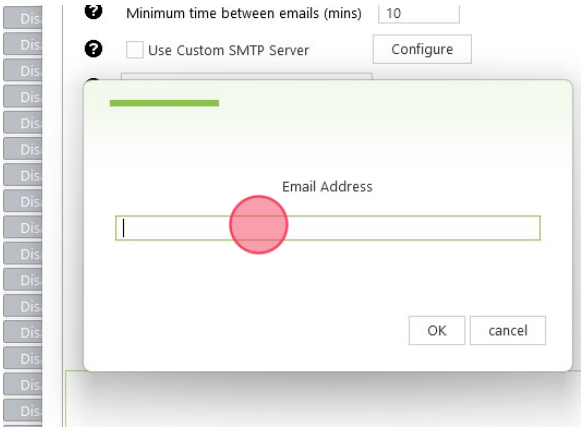
4. Click the "Green +" icon

> **Tip:** You can add multiple email addresses

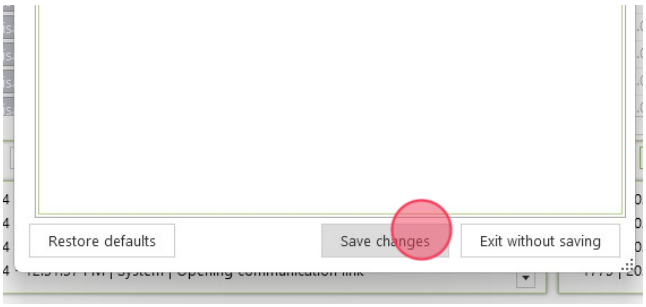


5. Enter your Email Address and click "OK"

> **Tip:** You can send yourself a test email to ensure it works properly



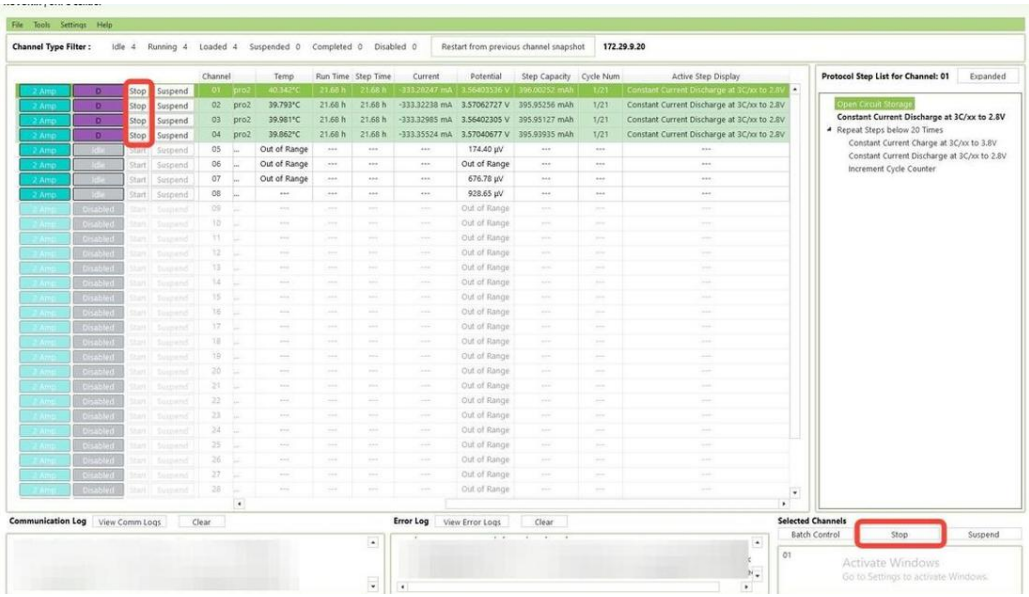
6. Click "Save changes"



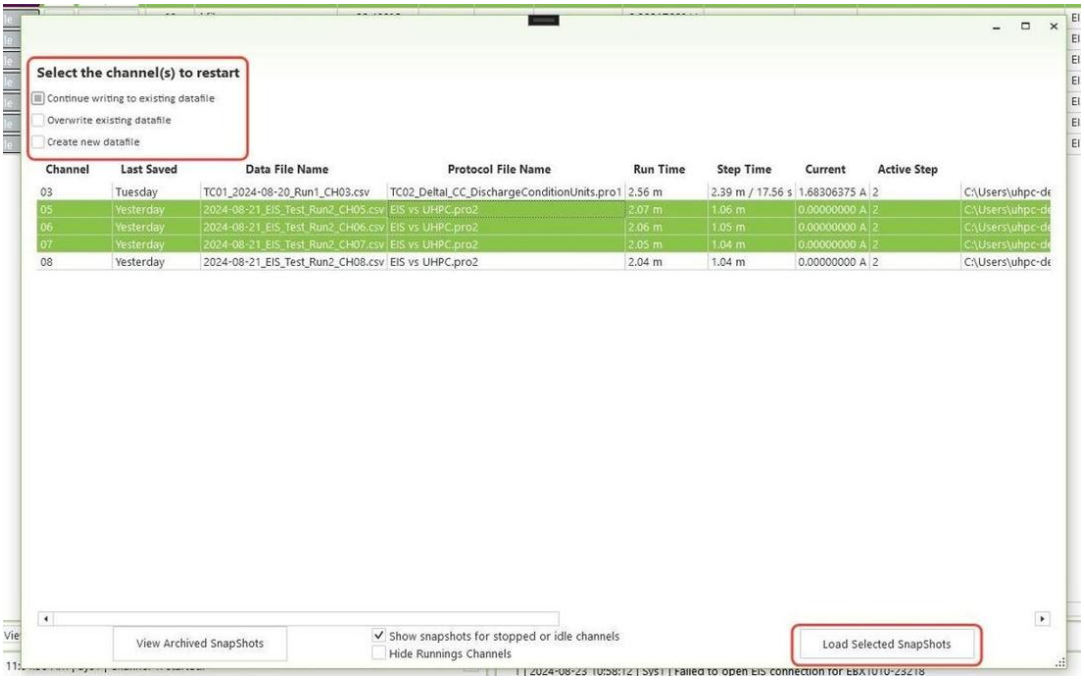
2.4 How to Stop and Resume Tests

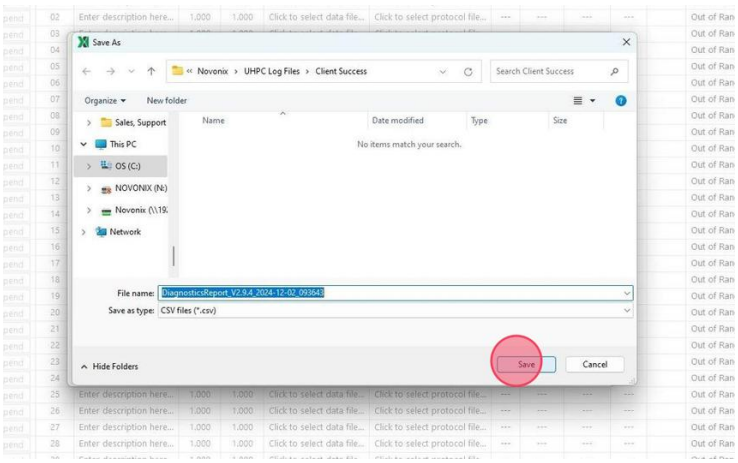
1. UHPC Software- How to Stop and Resume tests This guide provides step-by-step instructions on how to stop, exit, restart, and load snapshots in the UHPC Control Software. It explains how to safely interrupt connections and install updates without disrupting your tests. Your Snapshots and Data Files will be saved when you stop the tests. Please see guide "Migrating UHPC to a New Computer while running Tests" if your current computer is Windows 7 and you would like our new software. Pause or "Stop" you active Tests
2. Within your UHPC Control Software, Click "Stop" on all individual channels that tests are running. • Alternatively, select all running channels and click "Stop" in the bottom right hand corner.
3. Once your Channels are Stopped. Shutdown the UHPC Software by clicking "X" in the top right hand corner.

> ⚠ **Alert:** If you are using Windows 7 OS, you will not be able to install our latest versions of software.



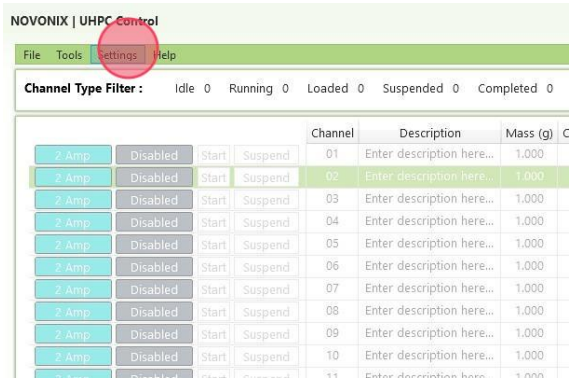
4. Now you can safely Install Software updates or Interrupt Hardware connections without disrupting your tests. Resume Your Tests from Previous Channel Snapshot • From UHPC Control Click "Restart from previous channel snapshot."
5. Select the tests you want to restart by choosing the relevant channels (hold "Ctrl/Shift" to select multiple) • Indicate where to store the new data by checking the appropriate box. By default, data will be written to the existing data file.
6. Click "Load Selected SnapShots" to proceed. Your tests should pick up from where they left off, with the current and voltage remaining unchanged. com for help recovering any missing datafiles.



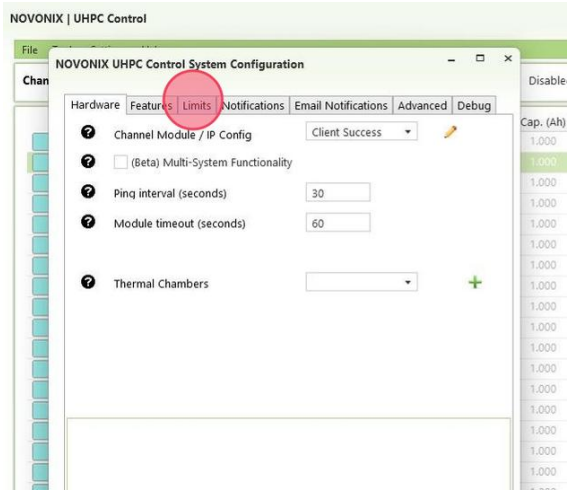


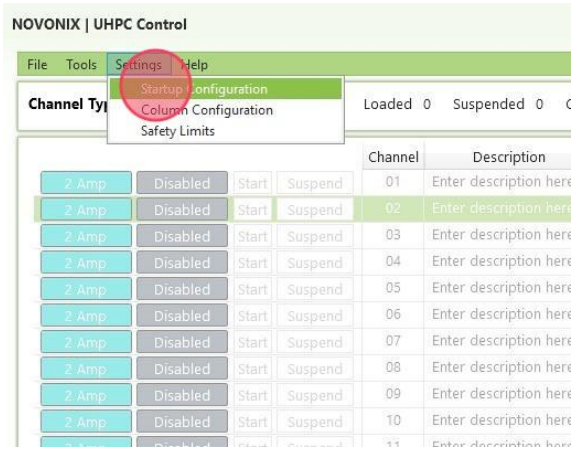
2.5 How to Disable Temperature Limits

1. How to Disable Temperature Limits in UHPC Control This guide provides steps to disable temperature limits in UHPC Control, allowing users to customize their system settings. By following the instructions, users can bypass potential error messages for breaching global temperature limits. In UHPC Control, click "Settings"

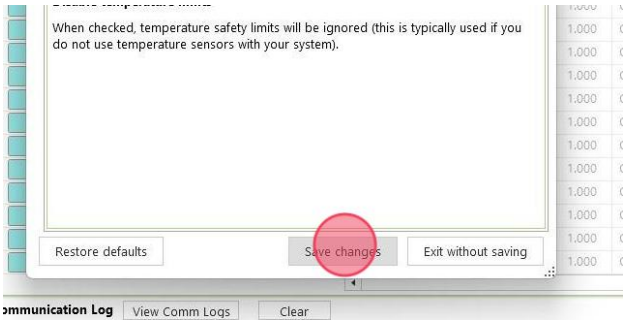


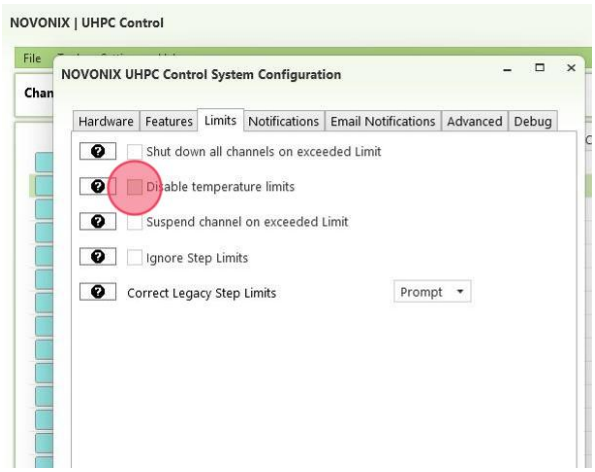
2. Click "Startup Configuration" Click the "Limits" tab.





3. Click "Disable temperature limits" After the "Disable temperature limits" box is checked. Click "Save changes"

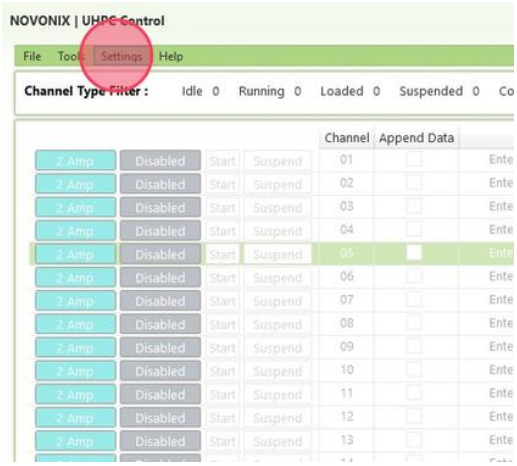




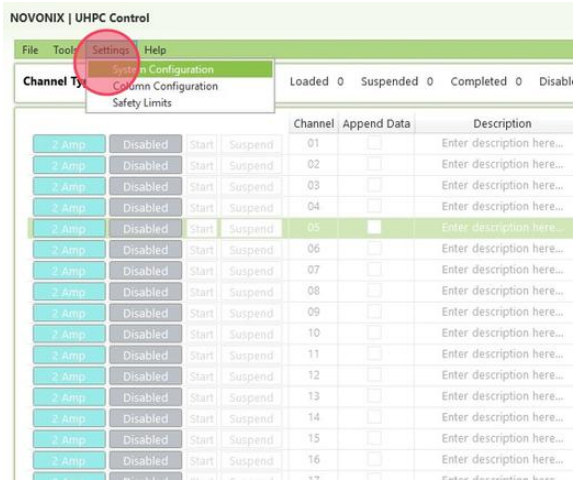
4. If you disable temperature limits, UHPC Control will ignore any errors that would be thrown for breaching global temperature limits.

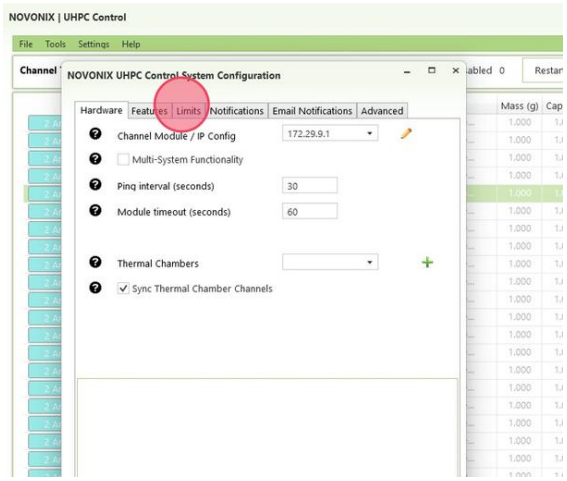
2.6 How to Enable Negative Voltage for Cells Starting Below 0V

1. UHPC Control – How to Enable Negative Voltage for Cells Starting Slightly Below 0 V Follow the steps below to enable negative voltage in UHPC Control.
2. This feature allows testing to begin with cells that start slightly below 0 V.
3. Open UHPC Control. • Click the Settings tab.

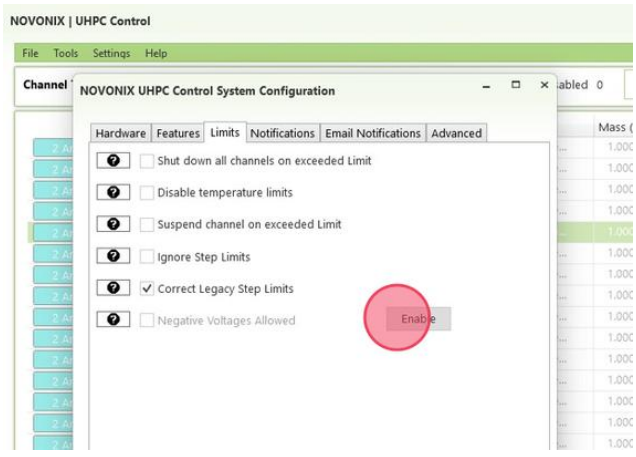


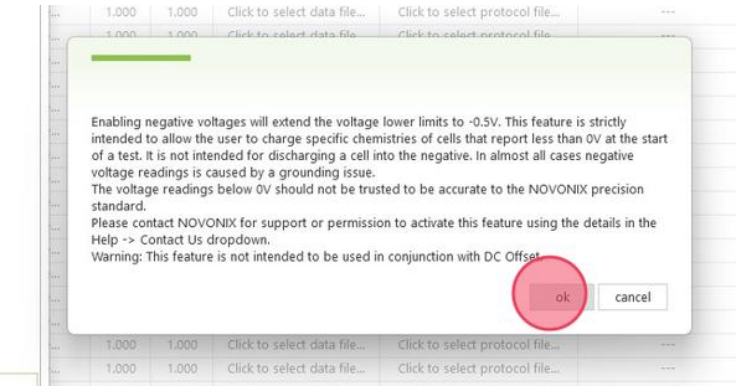
4. Select the System Configuration tab. Navigate to the Limits tab.



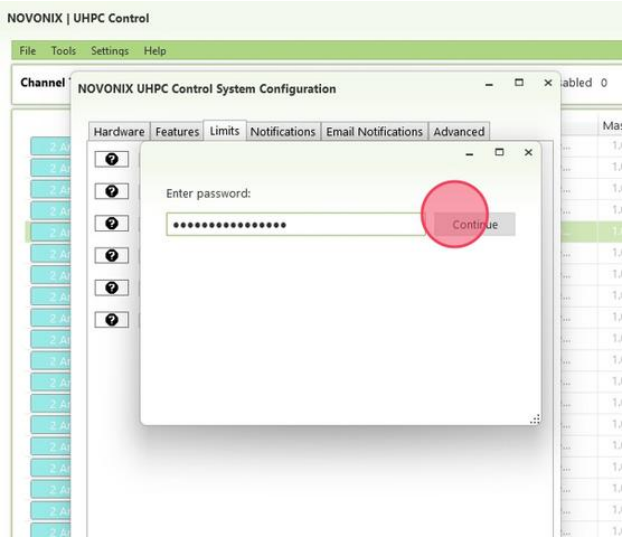


5. Click the Enable button. Review the popup message carefully, then click OK.





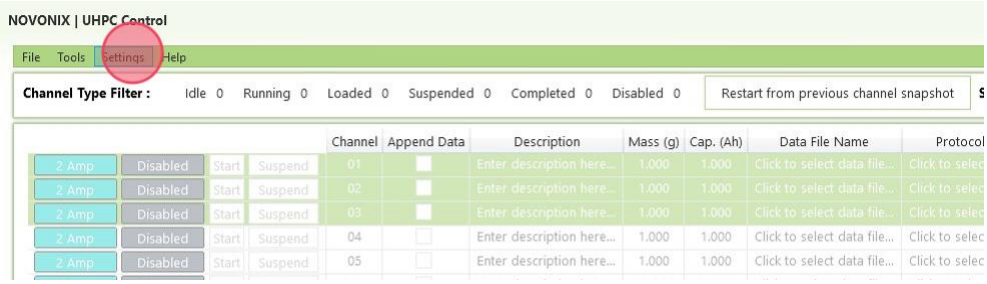
6. Enter the password: SpecialChemistry.
7. Click Continue. Click Save Changes.



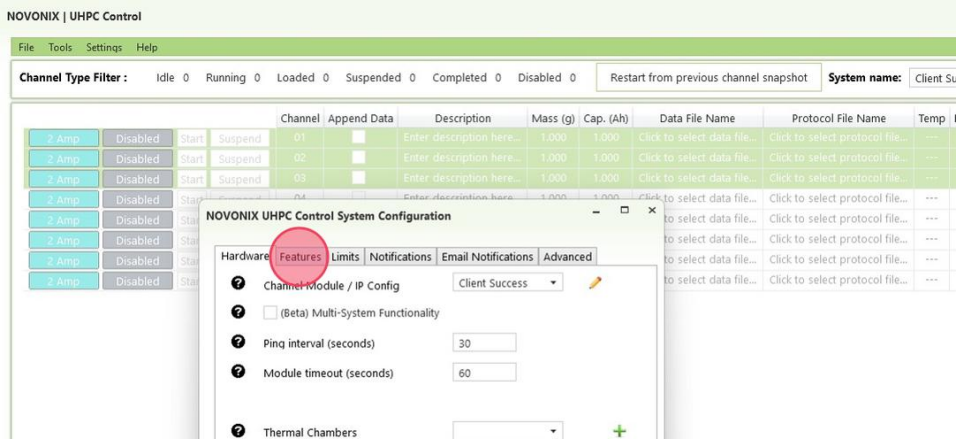
8. Enable Negative Voltages Enabling negative voltages will extend the voltage lower limits to -0.5 V. This feature is strictly intended to allow the user to charge specific chemistries of cells that report less than 0 V at the start of a test. It is not intended for discharging a cell into the negative. In almost all cases, negative voltage readings are caused by a grounding issue.
9. The voltage readings below 0 V should not be trusted to be accurate to the NOVONIX precision standard. Please contact NOVONIX for support or permission to activate this feature using the details in the Help -> Contact Us dropdown. Warning: This feature is not intended to be used in conjunction with DC Offset

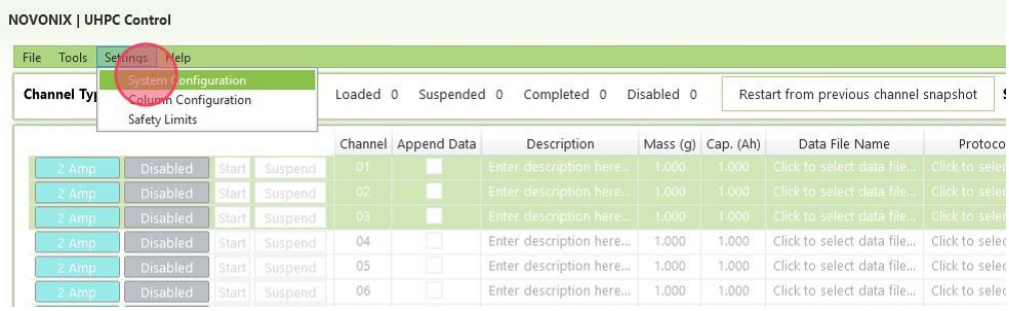
2.7 How to Disable Dynamic Current for CCCV Measurements

1. UHPC Software- How to Disable Dynamic Current for CCCV Measurements By following these instructions, users can improve system performance during CCCV measurements by using a single resistor based on the protocol's initial current set point. This helps minimize unwanted transients at resistor switch points, resulting in less noise in your data. Click "Settings" in UHPC Control

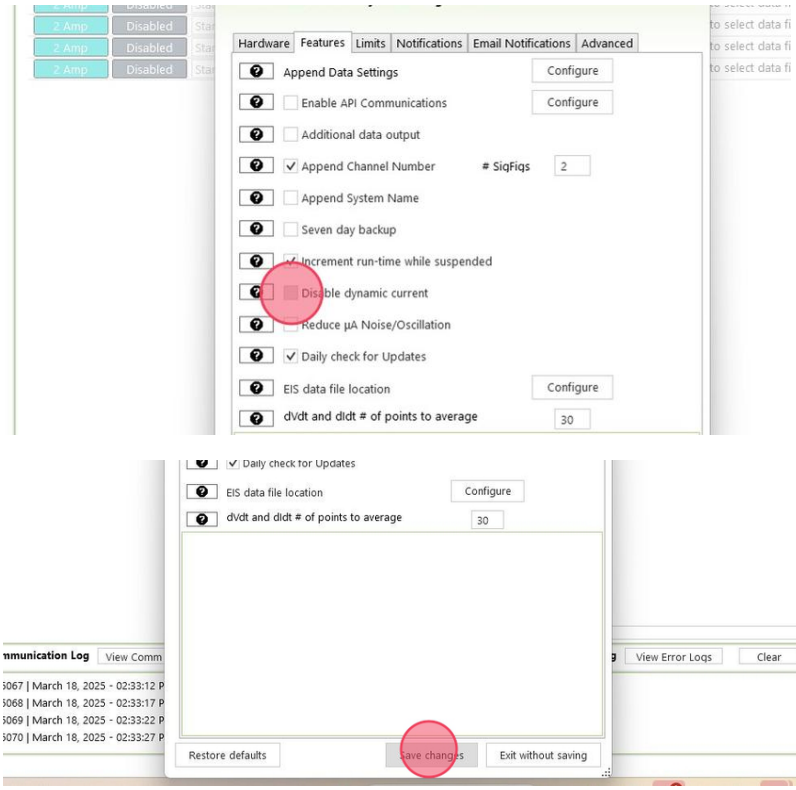


2. Click "System Configuration" Click "Features" tab





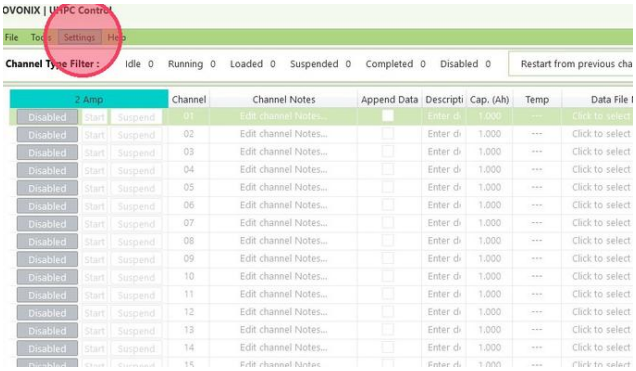
3. Click "Disable dynamic current" box Click "Save changes"



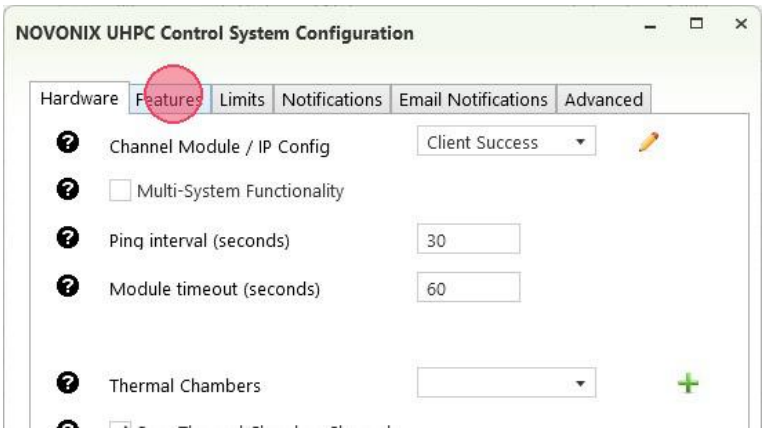
> **Tip:** Now, you'll experience less noise in the CCCV charge and discharge due to reduced range switching between resistors, which previously introduced small transients at the switch points.

2.8 How to Keep a Third Backup File Locally or on a Network Drive

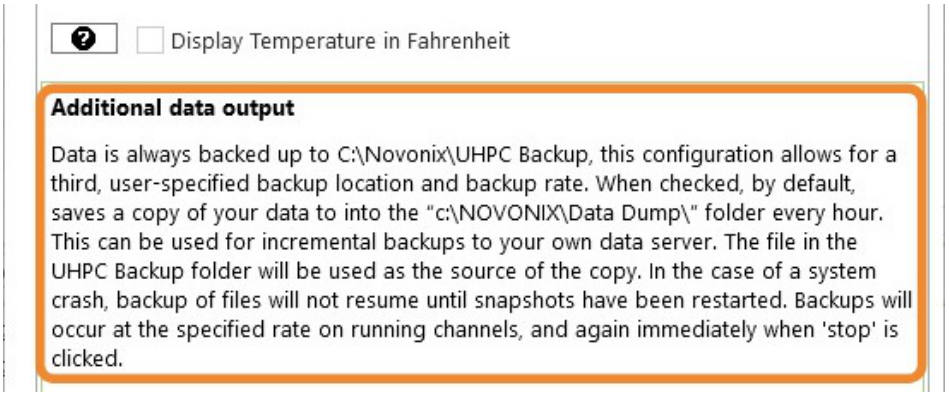
1. UHPC Control- How To Keep a Third Backup File Locally or on a Network Drive This guide shows how to enable UHPC Control's Additional Data Output to create a third backup copy of your UHPC datafiles to a chosen local or network folder. Follow it to add redundancy and protect data automatically. • Users must be running UHPC Control version 2.16.0 or later.
2. Open the UHPC Control software. • Click Settings.

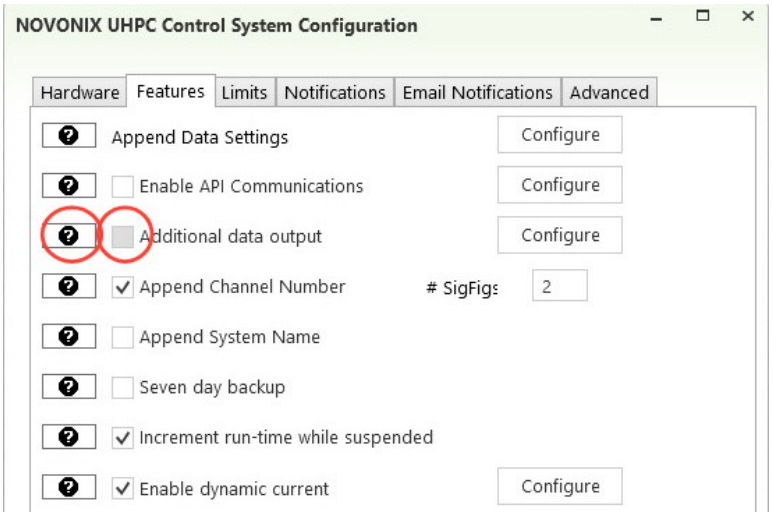


3. Click System Configuration. Click Features tab.

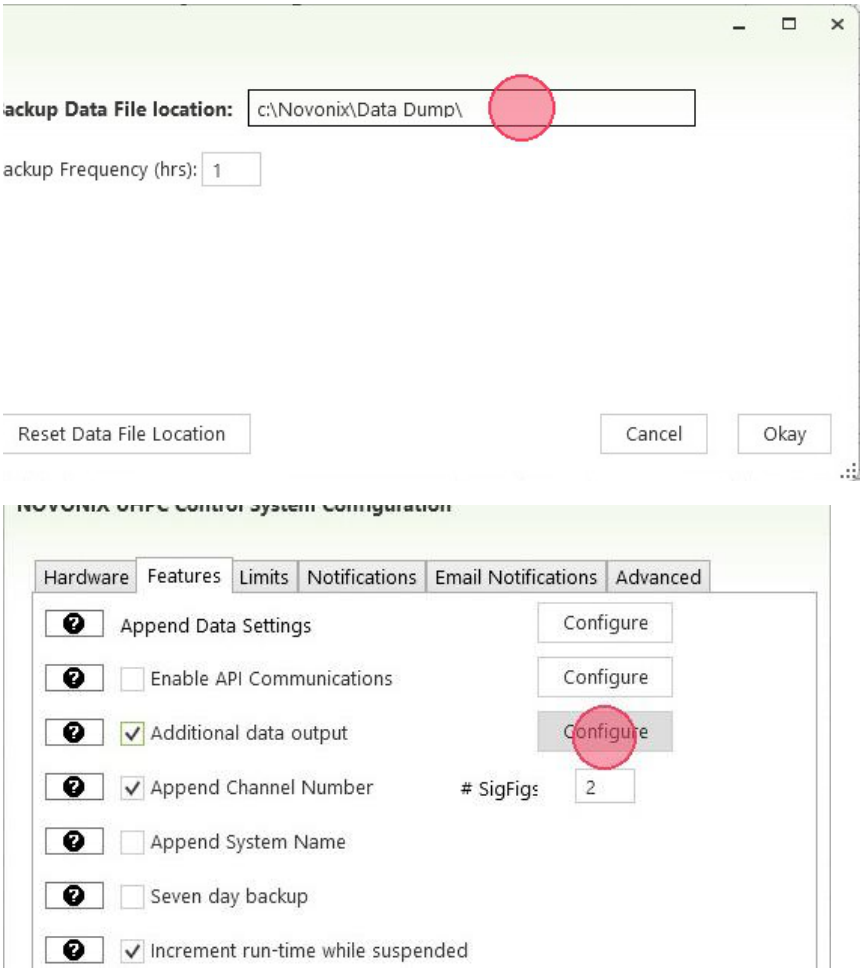


4. • Click the Additional Data Output checkbox. More details about this feature.

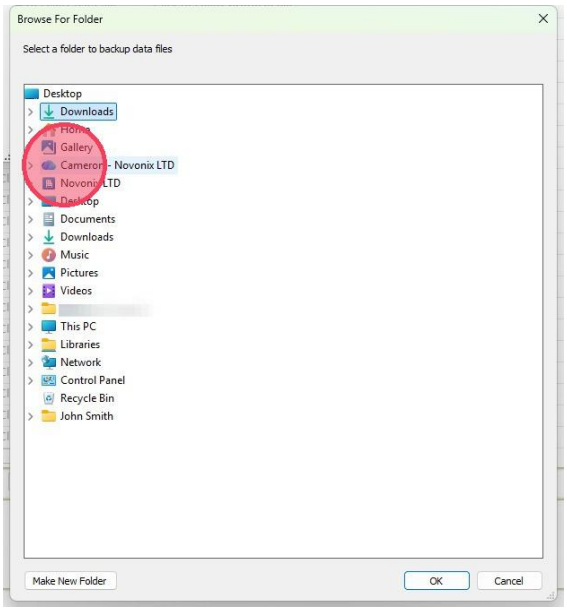


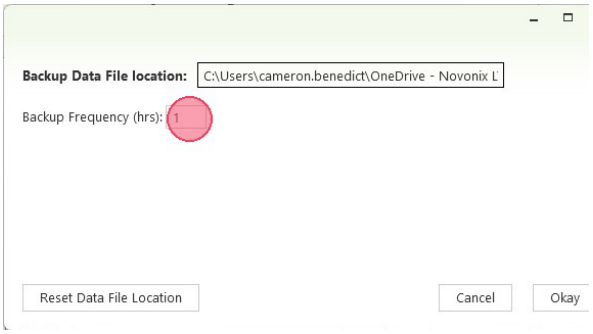


5. Click Configure button. Click Backup File Location Text box.

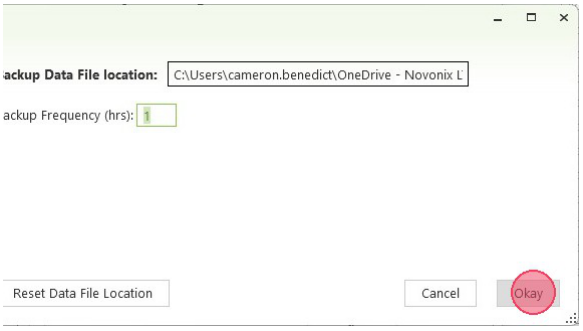


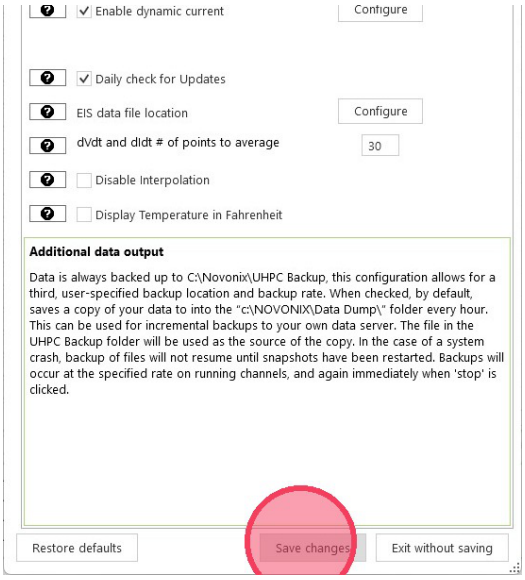
6. • Click the text box to select either a local file path or a network file path. • Once you have selected your preferred file path, click OK. Use the Backup Frequency text box to specify how often your data files are copied.





7. Click OK when you are finished. When complete, click Save Changes in the System Configuration tab.





2.9 How to Use the New Improved CV Functionality

1. UHPC Software: How to Use the New Improved CV Functionality (UHPC Control V2.14.0) and Understand Noise in Past CV Hold Software Versions The Improved Constant Voltage (CV) functionality allows you to monitor self-discharge rates more effectively and quickly screen cells in both QC and R&D workflows.
2. Key benefits: Enables more stable CV steps with reduced oscillations. Supports seamless transitions between positive and negative currents. Provides flexibility in managing resistors for better control during CV steps.
3. New Capabilities • Graceful CV Start • CC-CV (charge or discharge) steps now start smoothly within 0.005 V of the target, regardless of current direction. • OCV to CCCV • OCV to CCCV transitions are now supported with both positive and negative currents, in either charge or discharge mode. • Seamless Transitions • UHPC moves across 0 A without interrupting the CV step, ensuring stability when crossing current directions. • Dynamic Current Management
4. Resistors can be enabled or disabled via: Settings → System Configuration → Features → Enable Dynamic Current (Configure CV Ranges) • Replaces the "Reduce noise/oscillation" option, allowing finer control over oscillation in larger/noisier cells.

5. Why Noise occurred in Previous versions of software UHPC systems use multiple precision shunt resistors that dynamically switch based on the magnitude of current. This maximizes resolution and accuracy. However, during extremely low-current CV holds, where voltage regulation is highly sensitive, switching between these resistors can introduce a feedback loop.

A small voltage deviation (tens of µV) may trigger a range switch. • If the correction current needed is just above the lower range limit, the system may jump back and forth between ranges.

This can appear as oscillations or noise during CV holds. This behavior is most noticeable in medium to large cells (21700s, pouch cells) where even minor corrections exceed the capacity of lower resistor ranges.

UHPC Current Ranges by Model Each UHPC module includes the following current measurement ranges:

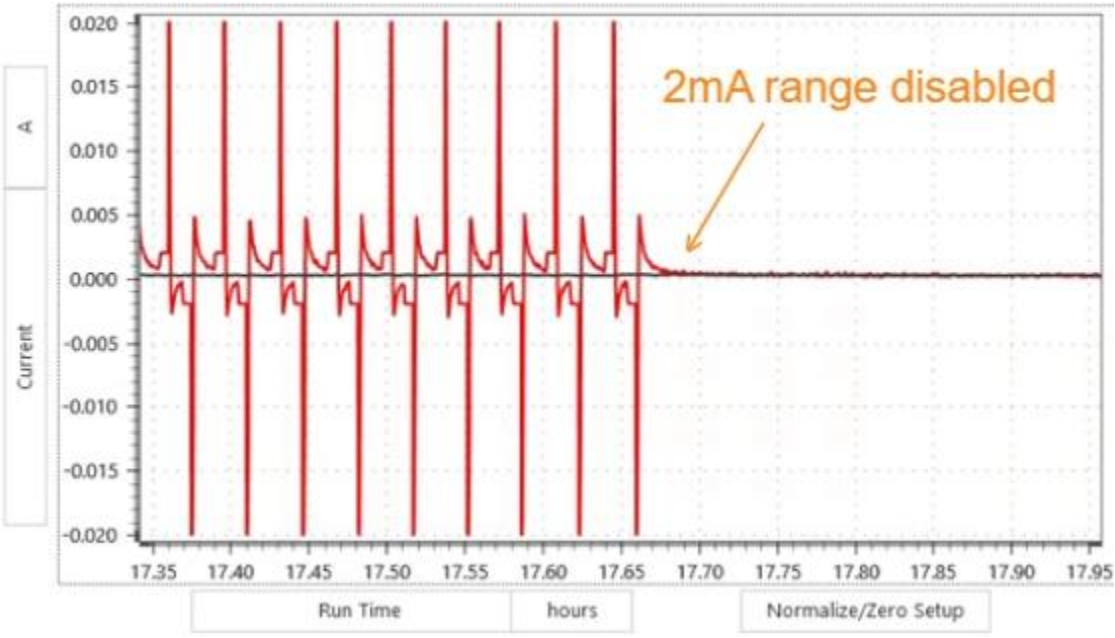
UHPC 2A • 200 µA, 2 mA, 20 mA, 200 mA, 2 A

UHPC 10A • 100 µA, 1 mA, 10 mA, 100 mA, 1 A, 10 A

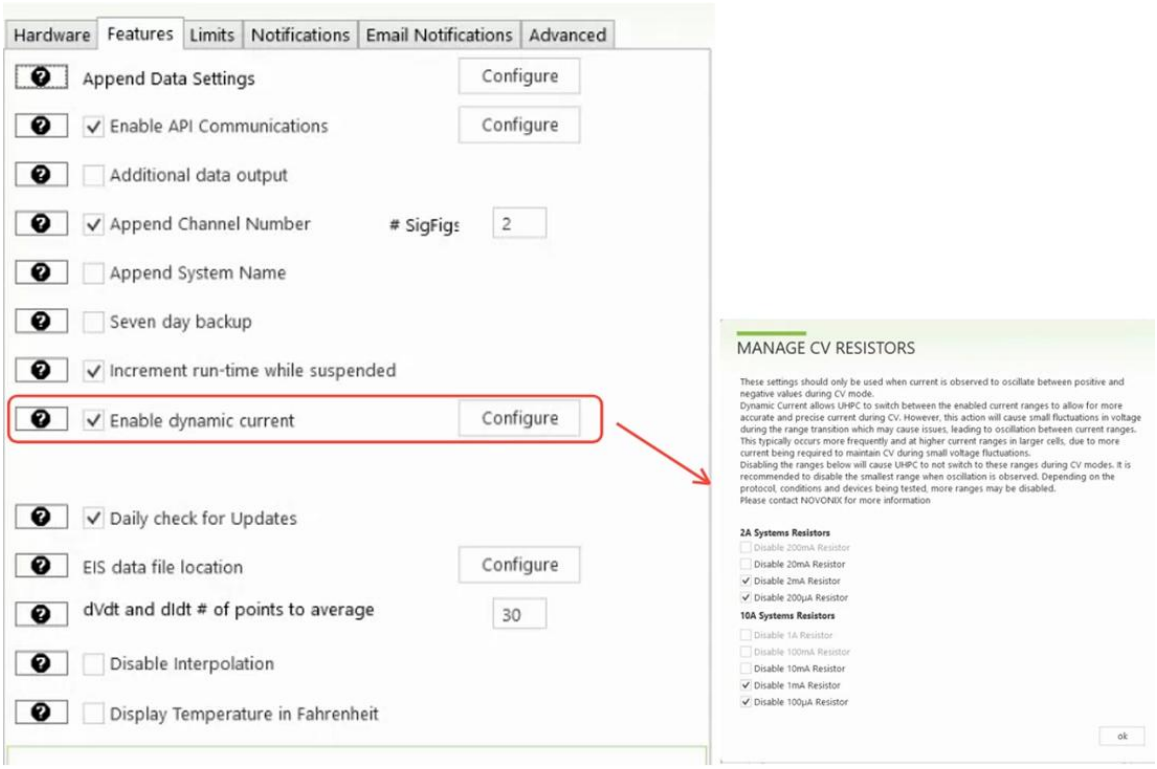
UHPC 20A • 2 A, 20 A

6. Example Scenario: • When a 2A module switches from a higher current range (e.g. 20 mA) to a lower range (e.g. 2 mA), a small voltage deviation (~10s of µV) may occur. • The UHPC attempts to correct this by adjusting the current. But if it needs, say, 2.5 mA to maintain voltage, and it's in a 2 mA range, it may jump back to 20 mA.

   This can lead to rapid back-and-forth switching, appearing as noise during CV holds. This behavior is most noticeable in medium to large cells like 21700s or pouch cells, where even tiny adjustments require more than the lower resistor range can handle.



7. Dynamic Current Management • Enable Dynamic Current in UHPC Control
8. Navigate to UHPC Control Settings → System Configuration → Features. • Select Enable Dynamic Current (Configure CV Ranges). • Configure Resistor Management • Disable lower ranges that may cause oscillation during CV. • Save changes.



9. Important: The decision to disable specific resistors should be based on:

   Cell capacity • Expected self-discharge current • Voltage regulation sensitivity • Time scale of the CV hold For larger cells (e.g., 21700 or high-capacity pouch cells): • These may require slightly higher correction currents. In these cases, using a mid-range current resistor (e.g., 20 mA or 200 mA) might yield smoother results.

   For smaller cells (e.g., coin cells): • The lower current ranges (e.g., 200 µA or 2 mA) are typically appropriate and do not need to be disabled.

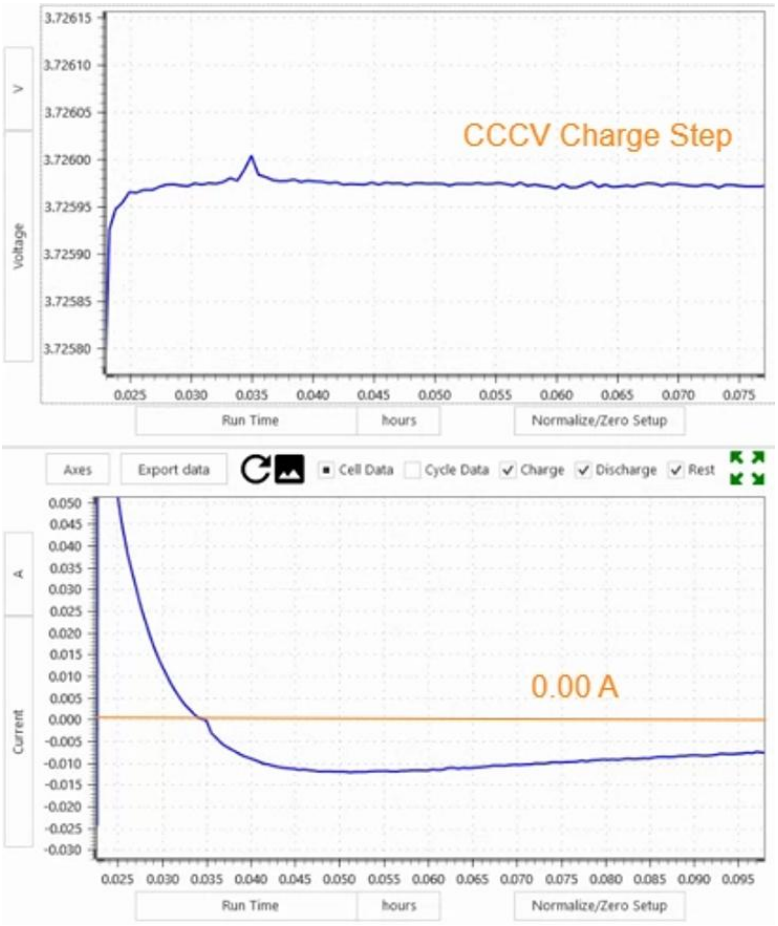
10. Integrating OCV with CV Holds in UHPC Protocol To prevent skipped steps and improve consistency, the new workflow allows you to capture the Open Circuit Voltage (OCV) before running a CV hold. Step Sequence

    Example 1. OCV Step • Captures the cells voltage as a variable (e.g., Var01) using Update Variable Action. 2. CCCV Step (Charge or Discharge) • Uses the captured OCV variable as the Upper or Lower cutoff voltage. • Example: • For discharge: cutoff = Var01 • For charge: cutoff = Var01

    Why This Matters • Ensures the CV hold starts relative to the actual measured state of the cell. • Standardizes testing across cells with slightly different initial voltages. • Prevents skipped CV steps:

    In past software versions, a small overshoot or voltage drop (+-0.005 V) could cause the next CV step to be skipped, since the target cutoff was already reached. • Capturing OCV as a variable avoids this problem and guarantees the CV step runs as intended. • UHPC moves across 0 A without interrupting the CV step, ensuring stability when crossing current directions.

11. Seamless Current Direction Switching in CCCV Steps • UHPC will seamlessly switch between positive and negative current during any CCCV step. • If voltage fluctuations cause the current to change direction, the UHPC will apply whichever current is necessary to maintain the target voltage.
12. See the example below, which shows the UHPC sourcing negative current during a CCCV charge step to maintain the target voltage.



13. Summary and Best Practices Summary:

    Issue: Oscillations or skipped CV steps caused by resistor switching and overshoot/drop.
    • When: Most noticeable during self-discharge testing of larger cells.

Solution: • Use Dynamic Current to disable lower ranges. • Add an OCV step to update voltage as a custom variable and use it as the cutoff voltage in your next CV step. • Result: Stable, accurate CV hold with reliable self-discharge data.

Best Practices: • Use improved CV Hold for self-discharge testing and QC screening. • Disable lower ranges for larger cells where oscillations may occur. • Keep lower ranges enabled for small cells to maintain accuracy at low leakage currents.

2.10 Minimizing Channel Noise During CV Holds

1. UHPC Software: Minimizing Channel Noise During CV Holds When performing CV (constant voltage) holds, particularly for self-discharge measurements, you may observe small oscillations or instability in the current signal. This is often referred to as “channel noise” and can impact the precision of long-duration tests, especially when working with low-leakage cells. Understanding the source of this behavior and how to manage it will help ensure accurate and stable readings across a range of battery formats and test conditions.

   Why This Happens? UHPC systems are equipped with Multiple precision shunt resistors that dynamically switch based on the magnitude of current, optimizing resolution and accuracy. However, during extremely low-current CV holds, especially where voltage regulation is sensitive, switching between these resistors can introduce a feedback loop.

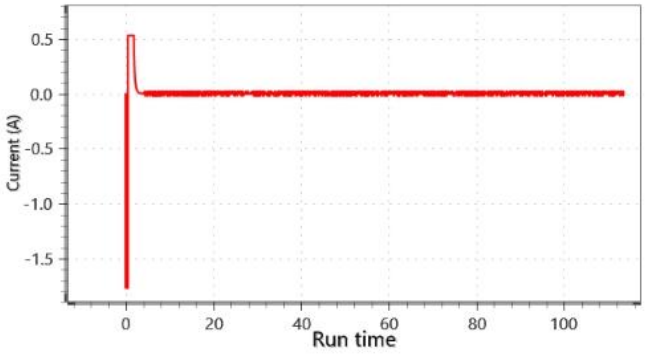
   UHPC Current Ranges by Model Each UHPC module includes the following current measurement ranges:

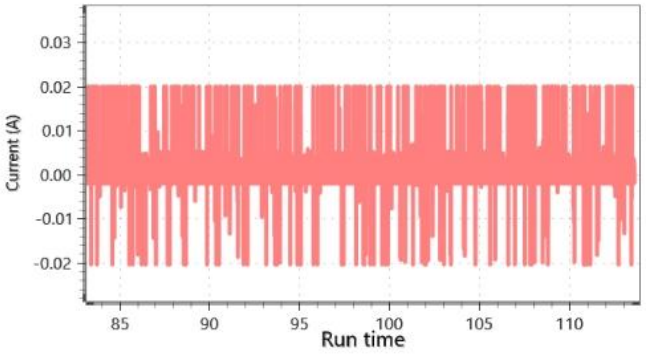
   UHPC 2A • 200 µA, 2 mA, 20 mA, 200 mA, 2 A

   UHPC 10A • 100 µA, 1 mA, 10 mA, 100 mA, 1 A, 10 A

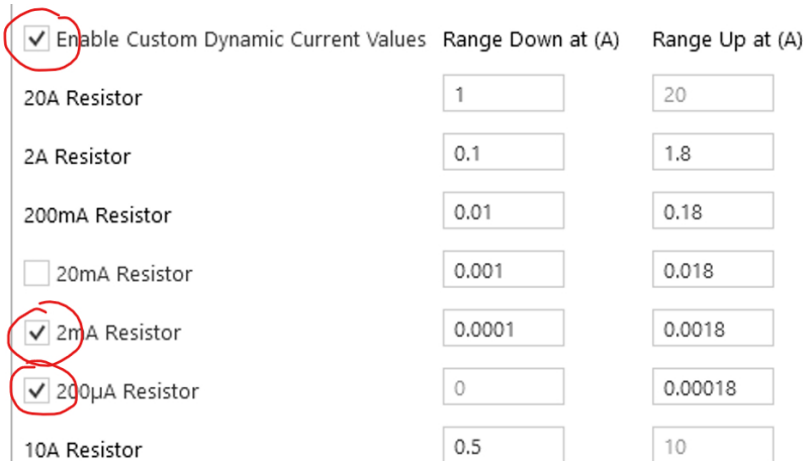
   UHPC 20A • 2 A, 20 A

2. Example Scenario: • When the system switches from a higher current range (e.g. 20 mA) to a lower range (e.g. 2 mA), a small voltage deviation (~10s of µV) may occur. • The UHPC attempts to correct this by adjusting the current. But if it needs, say, 2.5 mA to maintain voltage, and it’s in a 2 mA range, it may jump back to 20 mA.
3. This can lead to rapid back-and-forth switching, appearing as noise during CV holds. This behavior is most noticeable in medium to large cells like 21700s or pouch cells, where even tiny adjustments require more than the lower resistor range can handle.





4. Recommended Workaround To reduce channel noise during CV holds: • Access the Custom Dynamic Current Values in the UHPC Control System software. This workaround requires entry into password-protected advanced configuration pages. Use PW “NovonixHPC”
5. For certain cell types and test conditions, consider disabling one or more of the lowest current ranges (for example: 200 µA, 2 mA, or 100 µA) to prevent excessive range-switching. • This allows the system to remain stable in a higher current range that can accommodate minor voltage corrections without overshooting.



6. Important: The decision to disable specific resistors should be based on: • Cell capacity • Expected self-discharge current • Voltage regulation sensitivity • Time scale of the CV hold For larger cells (e.g., 21700 or high-capacity pouch cells): • These may require slightly higher correction currents. In these cases, using a mid-range current resistor (e.g., 20 mA or 200 mA) might yield smoother results.

   For smaller cells (e.g., coin cells): • The lower current ranges (e.g., 200 µA or 2 mA) are typically appropriate and do not need to be disabled.

   Issue: Oscillating or noisy current signal during CV holds •

   Cause: Resistor switching loop due to micro voltage adjustments triggering current range shifts • When It Occurs: Most common during CV holds for self-discharge testing •

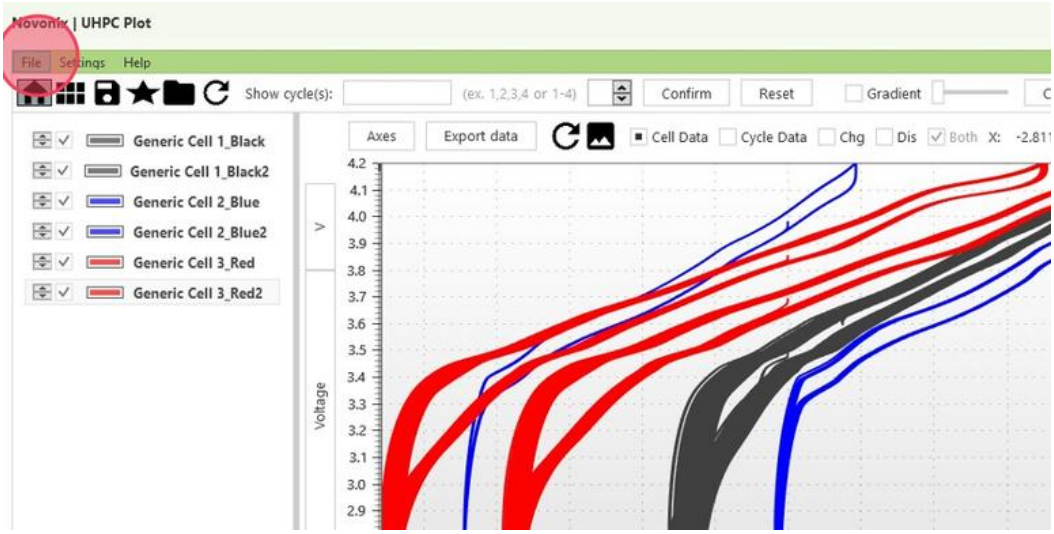
   Suggested Fix: • Use software to limit resistor switching • Disable lower current ranges if voltage corrections require more current than they allow • Adjust based on cell size and expected current leakage

3. Software — UHPC Plot

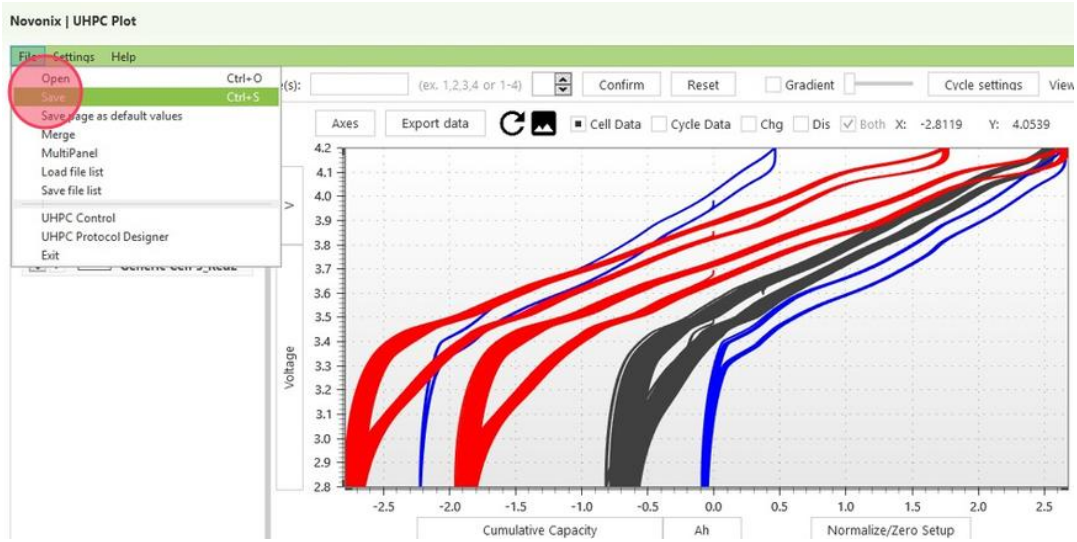
This section covers all guides related to the UHPC Plot software application, including exporting data, adjusting cycle settings, normalizing data, and viewing graphs.

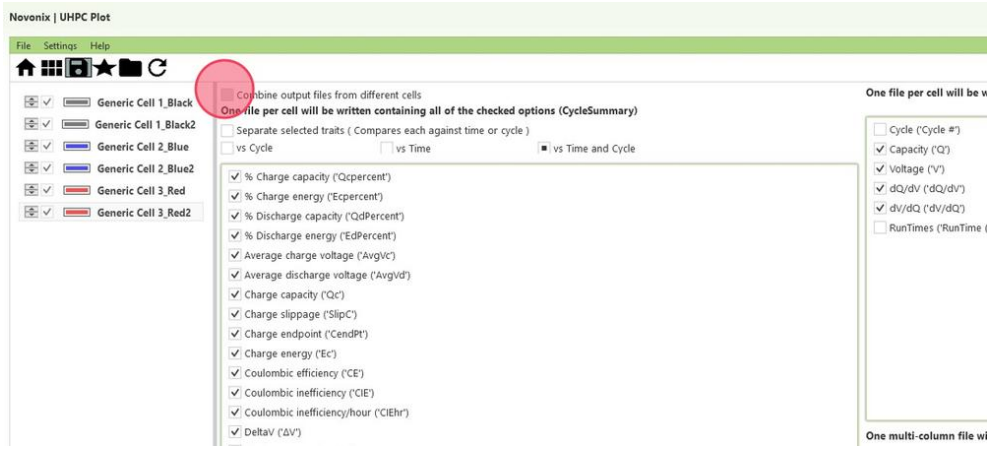
3.1 How to Export Cycle Data from UHPC Plot

1. UHPC Software – How to Export Cycle Data from UHPC Plot This guide offers a process for exporting cycle data from UHPC Plot into a CSV file, making data management more efficient. Click "File" in UHPC Plot.

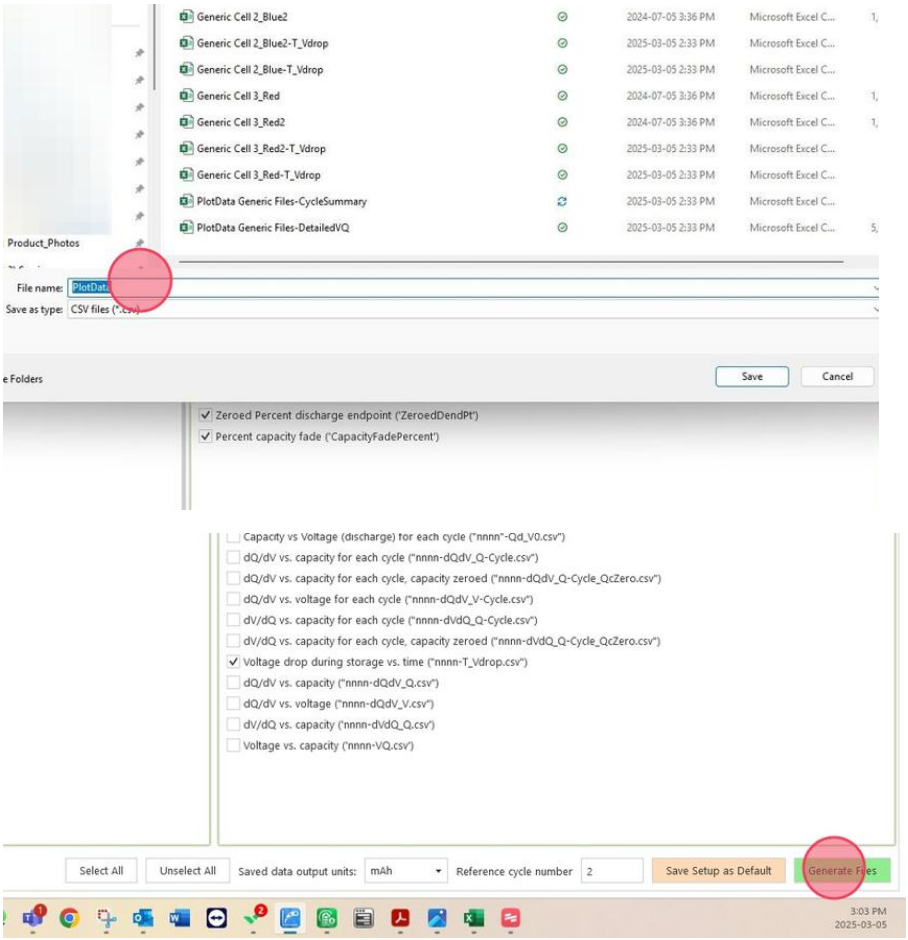


2. Click "Save" Click "Combine output files from different cells" if you want all data in a single CSV file. Select any checkboxes for the data you want to include in your CSV file.

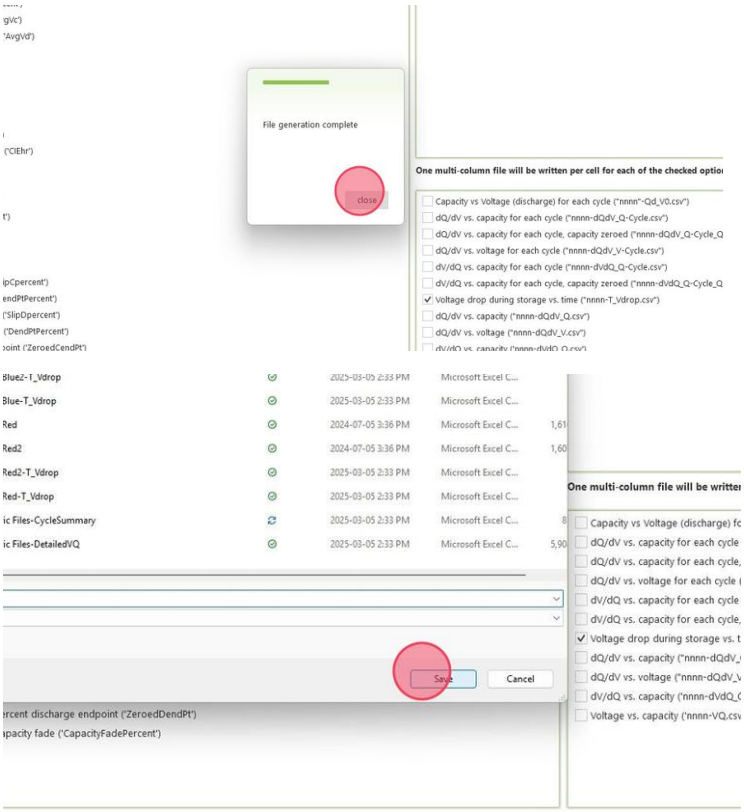




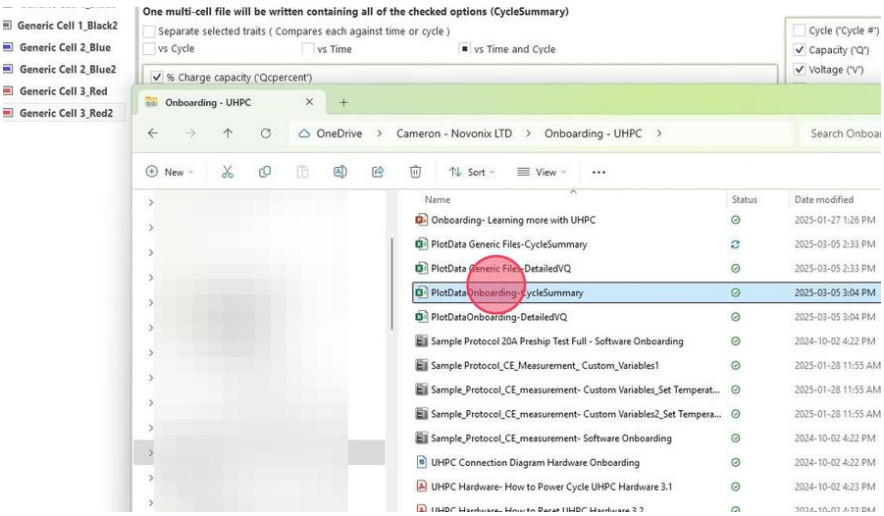
3. Click "Generate Files" Save the CSV file in your preferred folder with your chosen filename.

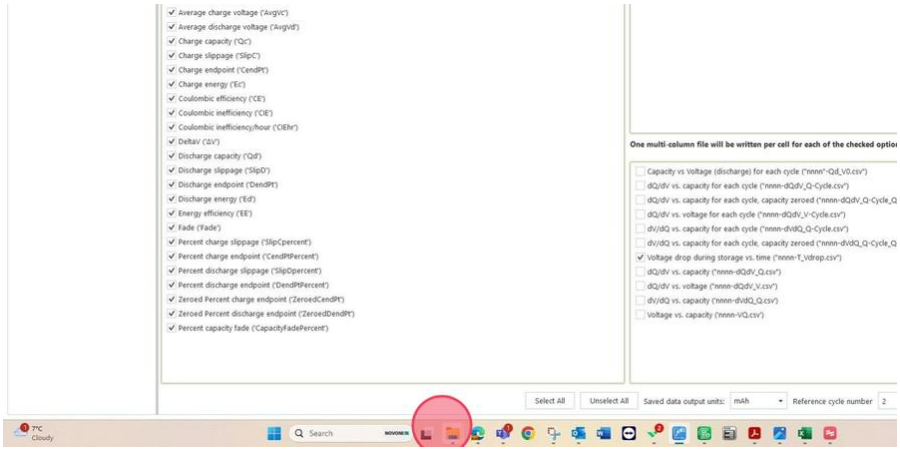


4. Click "Save" Click "close"

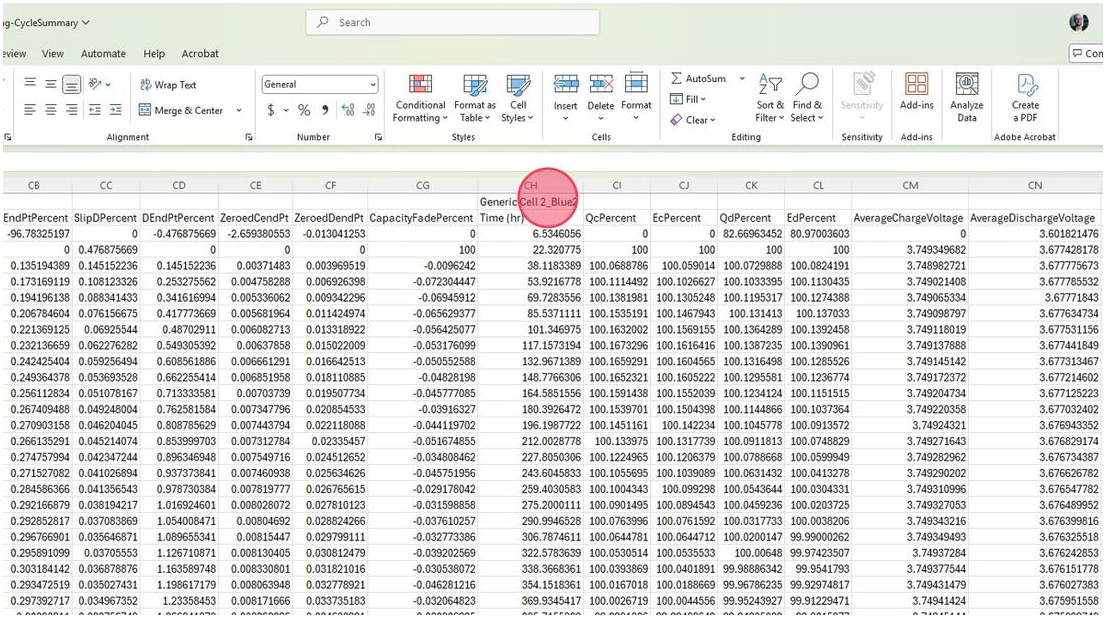


5. Open your "Windows File explorer" Select the CSV file you created in the previous steps.





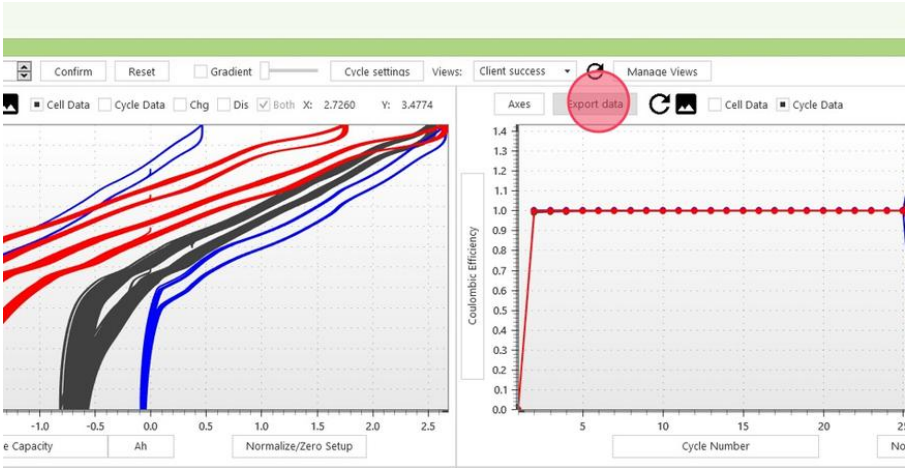
6. You now have a CSV file containing all the UHPC metric data you selected in the previous steps.



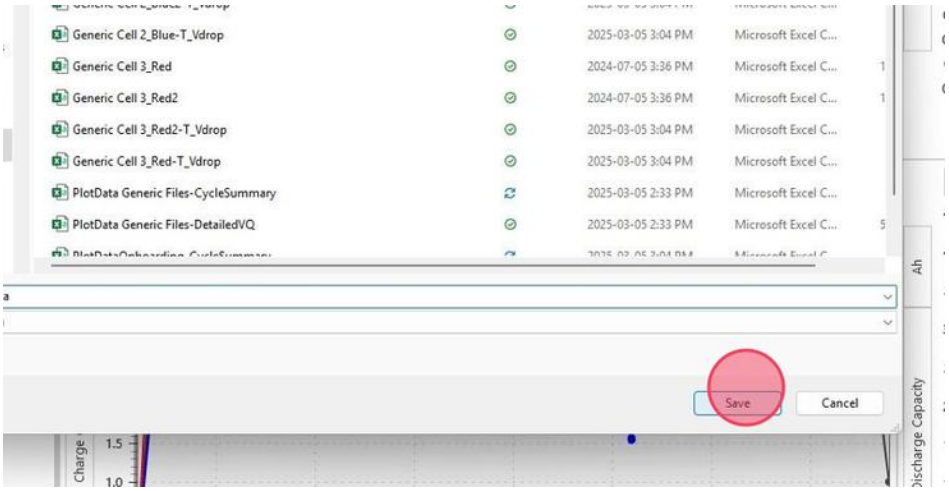
CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN
						Generic Cell 2_Blue2						
EndPtPercent	SlipDPercent	DEndPtPercent	ZeroedCendPt	ZeroedDendPt	CapacityFadePercent	Time (hr)	QcPercent	EcPercent	QdPercent	EdPercent	AverageChargeVoltage	AverageDischargeVoltage
-96.78325197	0	-0.476875669	-2.659380553	-0.013041253	0	6.5346056	0	0	82.66963452	80.97003603	0	3.601821476
0	0.476875669	0	0	0	100	22.320775	100	100	100	100	3.749349682	3.677428178
0.135194389	0.145152236	0.145152236	0.00371483	0.003969519	-0.0096242	38.1183389	100.0688786	100.059014	100.0729888	100.0824191	3.748982721	3.677775673
0.173169119	0.108123326	0.253275562	0.004758288	0.006926398	-0.072304447	53.9216778	100.1114492	100.1026627	100.1033395	100.1130435	3.749021408	3.677785532
0.194196138	0.088341433	0.341616994	0.005336062	0.009342296	-0.06945912	69.7283556	100.1381981	100.1305248	100.1195317	100.1274388	3.749065334	3.67771843
0.206784604	0.076156675	0.417773669	0.005681964	0.011424974	-0.065629377	85.5371111	100.1535191	100.1467943	100.131413	100.137033	3.749098797	3.677634734
0.221369125	0.06925544	0.48702911	0.006082713	0.013318922	-0.056425077	101.346975	100.1632002	100.1569155	100.1364289	100.1392458	3.749118019	3.677531156
0.232136659	0.062276282	0.549305392	0.00637858	0.015022009	-0.053176099	117.1573194	100.1673296	100.1616416	100.1387235	100.1390961	3.749137888	3.677441849
0.242425404	0.059256494	0.608561886	0.006661291	0.016642513	-0.050552588	132.9671389	100.1659291	100.1604565	100.1316498	100.1285526	3.749145142	3.677313467
0.249364378	0.053693528	0.662255414	0.006851958	0.018110885	-0.04828198	148.7766306	100.1652321	100.1605222	100.1295581	100.1236774	3.749172372	3.677214602
0.256112834	0.051078167	0.713333581	0.00703739	0.019507734	-0.045777085	164.5851556	100.1591438	100.1552039	100.1234124	100.1151515	3.749204734	3.677125223
0.267409488	0.049248004	0.762581584	0.007347796	0.020854533	-0.03916327	180.3926472	100.1539701	100.1504398	100.1144866	100.1037364	3.749220358	3.677032402
0.270903158	0.046204045	0.808785629	0.007443794	0.022118088	-0.044119702	196.1987722	100.1451161	100.142234	100.1045778	100.0913572	3.74924321	3.676943352
0.266135291	0.045214074	0.853999703	0.007312784	0.02335457	-0.051674855	212.0028778	100.133975	100.1317739	100.0911813	100.0748829	3.749271643	3.676829174
0.274757994	0.042347244	0.896346948	0.007549716	0.024512652	-0.034808462	227.8050306	100.1224965	100.1206379	100.0788668	100.0599949	3.749282962	3.676734387
0.271527082	0.041026894	0.937373841	0.007460938	0.025634626	-0.045751956	243.6045833	100.1055695	100.1039089	100.0631432	100.0413278	3.749290202	3.676626782
0.284586366	0.041356543	0.978730384	0.007819777	0.026765615	-0.029178042	259.4030583	100.1004343	100.099298	100.0543644	100.0304331	3.749310996	3.676547782
0.292166879	0.038194217	1.016924601	0.008028072	0.027810123	-0.031598858	275.2000111	100.0901495	100.0894543	100.0459236	100.0203725	3.749327053	3.676489952
0.292852817	0.037083869	1.054008471	0.00804692	0.028824266	-0.037610257	290.9946528	100.0763996	100.0761592	100.0317733	100.0038206	3.749343216	3.676399816
0.296766901	0.035646871	1.089655341	0.00815447	0.029799111	-0.032773386	306.7874611	100.0644781	100.0644712	100.0200147	99.99000262	3.749349493	3.676325518
0.295891099	0.03705553	1.126710871	0.008130405	0.030812479	-0.039202569	322.5783639	100.0530514	100.0535533	100.00648	99.97423507	3.74937284	3.676242853
0.303184142	0.036878876	1.163589748	0.008330801	0.031821016	-0.030538072	338.3668361	100.0393869	100.0401891	99.98886342	99.9541793	3.749377544	3.676151778
0.293472519	0.035027431	1.198617179	0.008063948	0.032778921	-0.046281216	354.1518361	100.0167018	100.0188669	99.96786235	99.92974817	3.749431479	3.676027383
0.297392717	0.034967352	1.23358453	0.008171666	0.033735183	-0.032064823	369.9345417	100.0026719	100.0044556	99.95243927	99.91229471	3.74941424	3.675951558

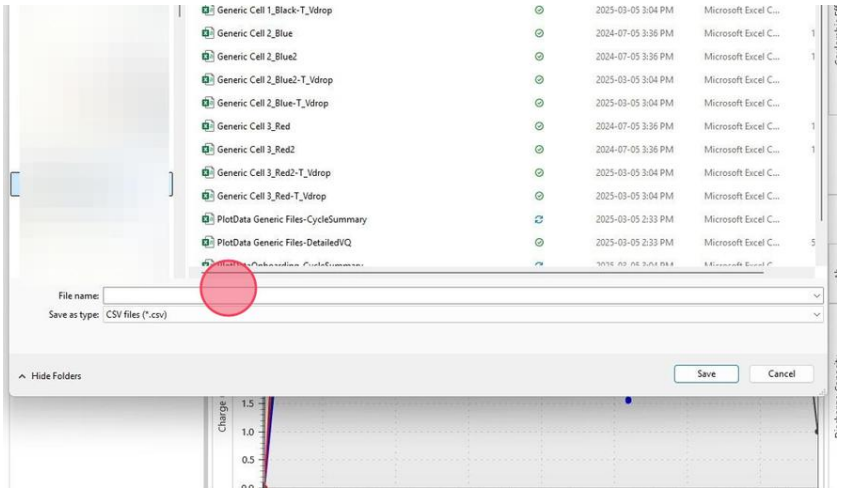
3.2 How to Export a UHPC Data File from a Single Graph

1. UHPC Software – How to Export a UHPC Data File from a Single Graph in UHPC Plot This guide offers a method for exporting data from a specific graph in UHPC Plot, ensuring you can easily save and access your data in CSV format. Click "Export Data" on the graph you want to save as a data file. In this example, I'm selecting the graph displaying Coulombic Efficiency data.

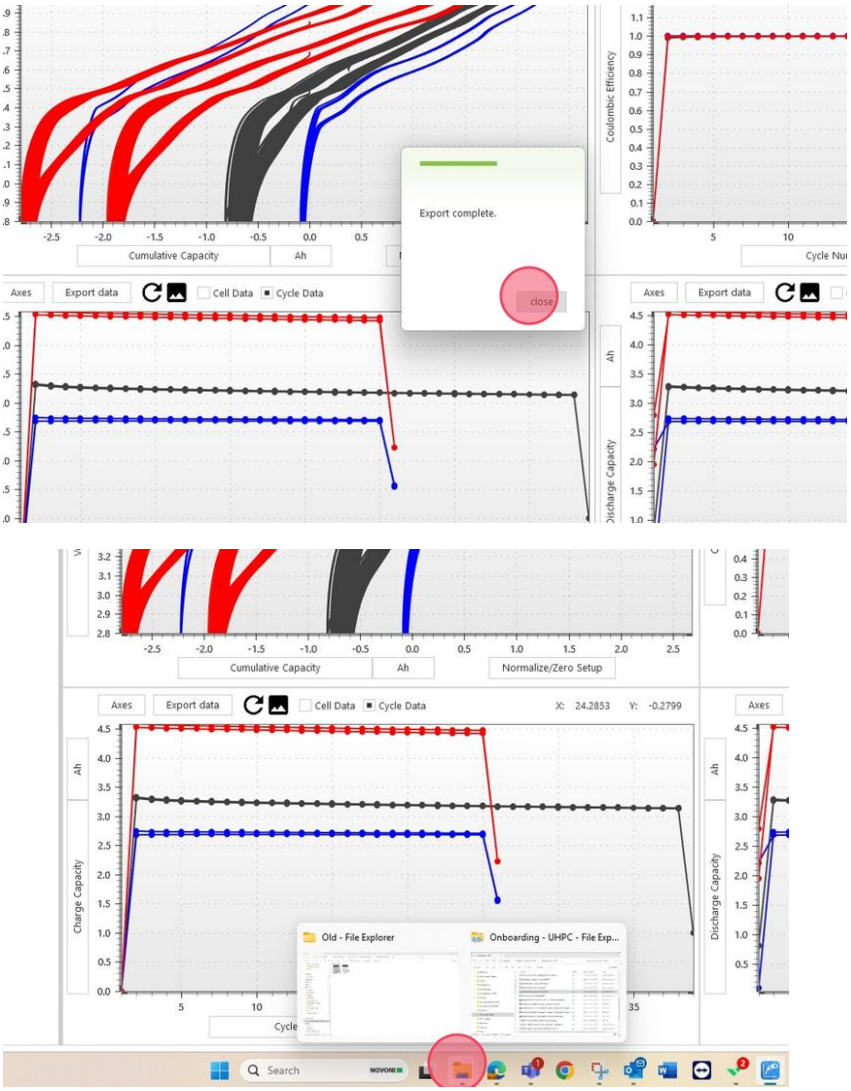


2. Save the CSV file in your preferred folder with your chosen filename. Click "Save"

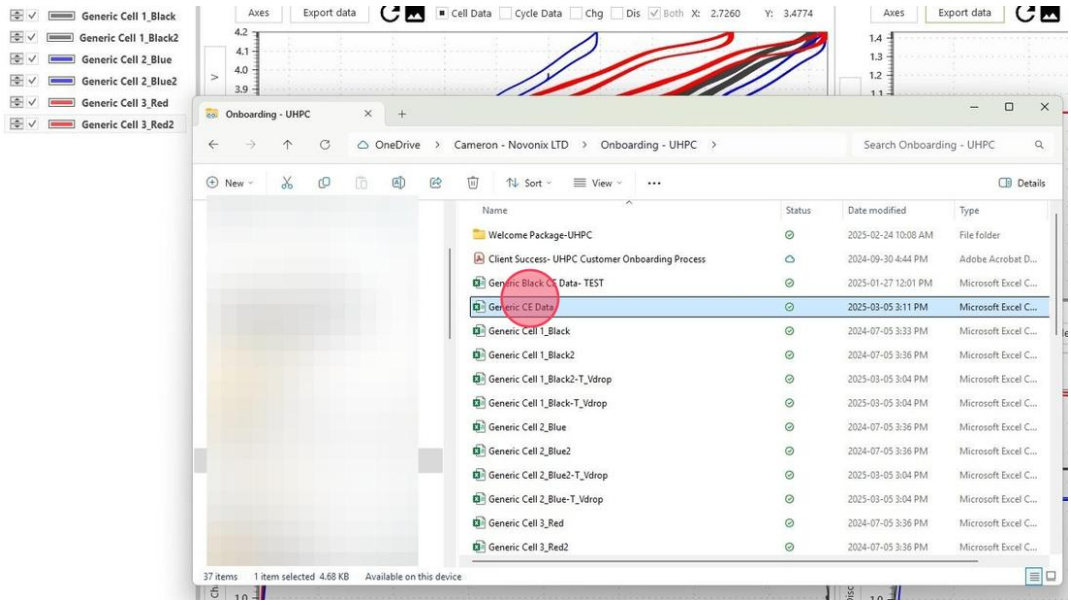


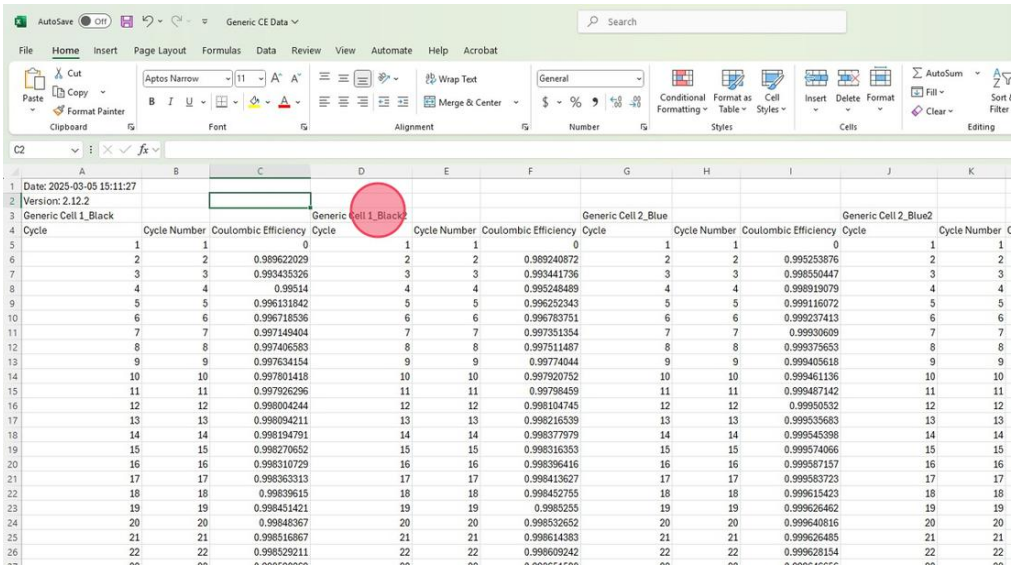


3. Click "close" Open your "Windows File explorer"



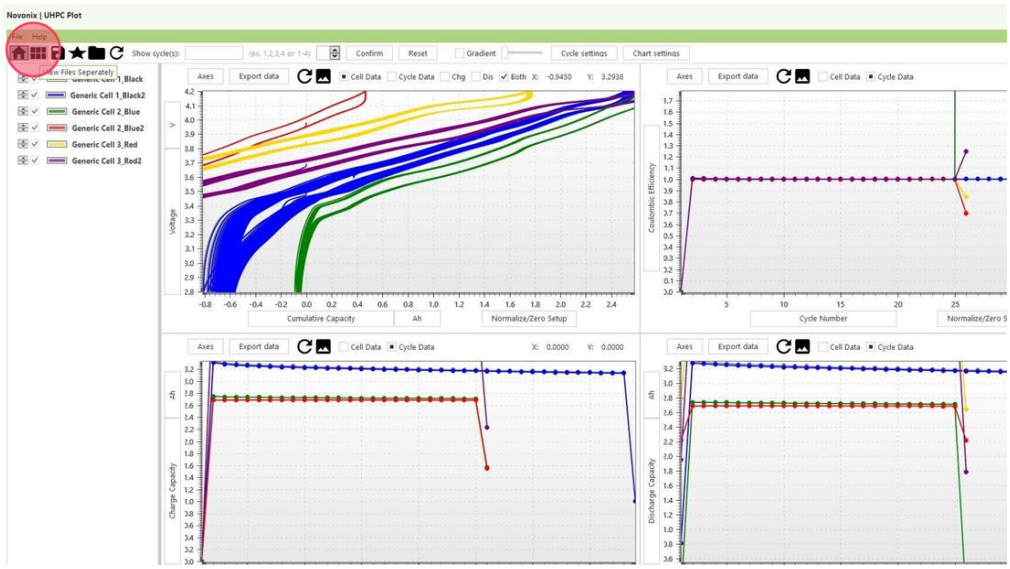
4. Select the CSV file you created in the previous steps. You now have a CSV file containing the data from your selected graph in Plot.



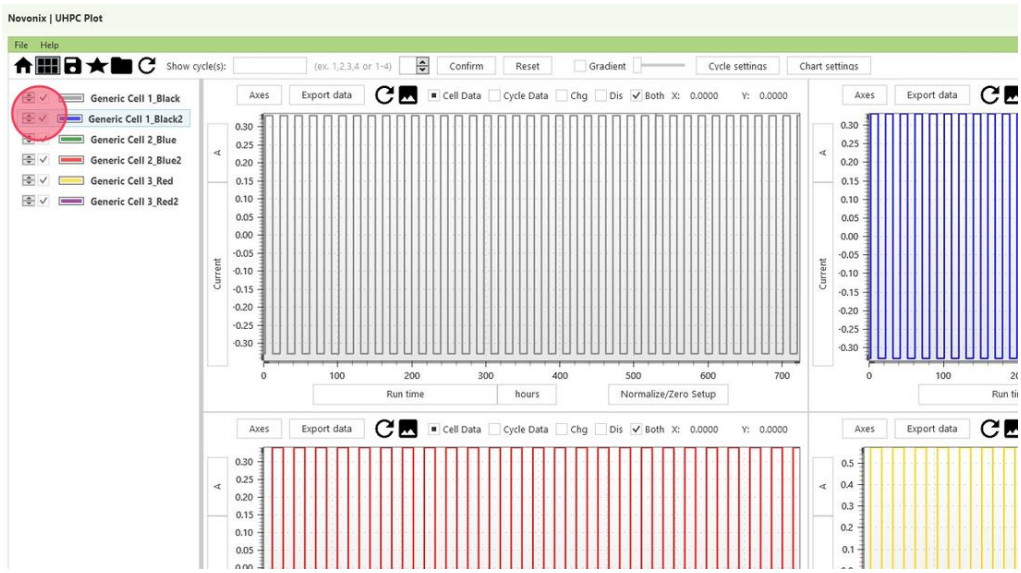


3.3 How to View Only One Graph in UHPC Plot

1. UHPC Plot- How to View only one graph This guide explains how to view only one graph on the UHPC Plot platform. By following the steps, users can easily filter out unwanted graphs and focus on a specific test. From the UHPC Plot home screen. • Click the View File Separately Button (Looks like 6 rectangles)



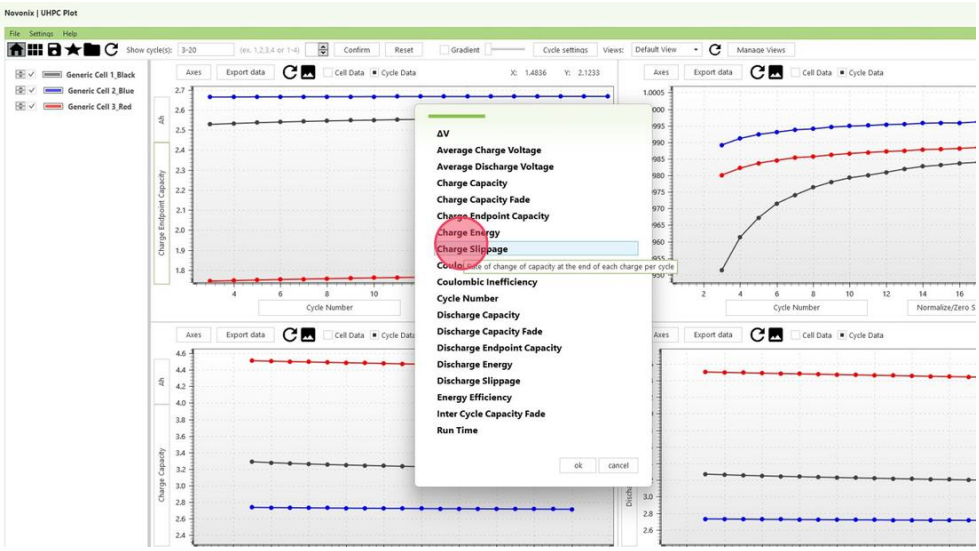
2. Once in the View File Separately tab. Navigate to the left part of screen. • Uncheck the tests that you do not want to view by clicking its box.



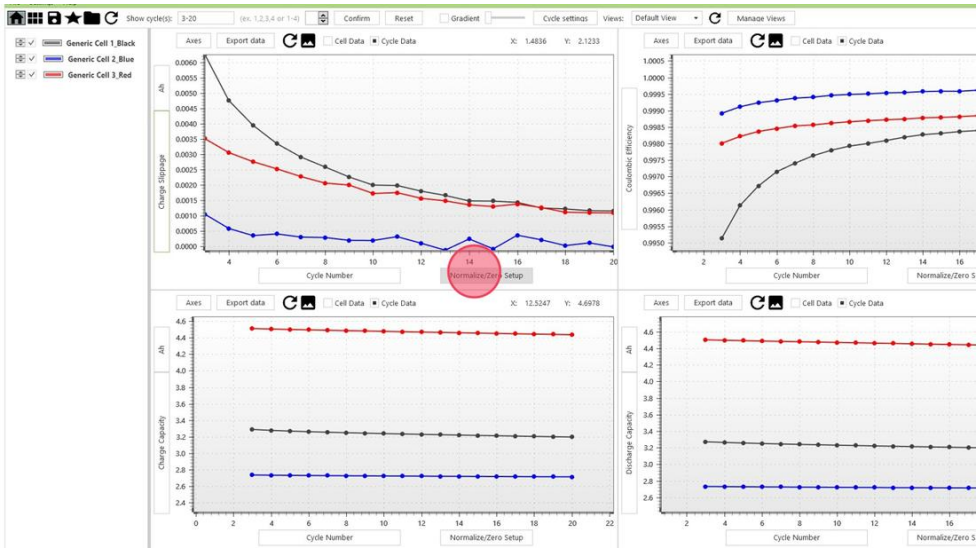
3. You should now see only one plot, which is the test that still has its box checked. The default plot is Current vs Runtime. If you leave the tab, it will return to this graph. You can select the metrics for your Y & X axes as you would for a graph on the home screen.

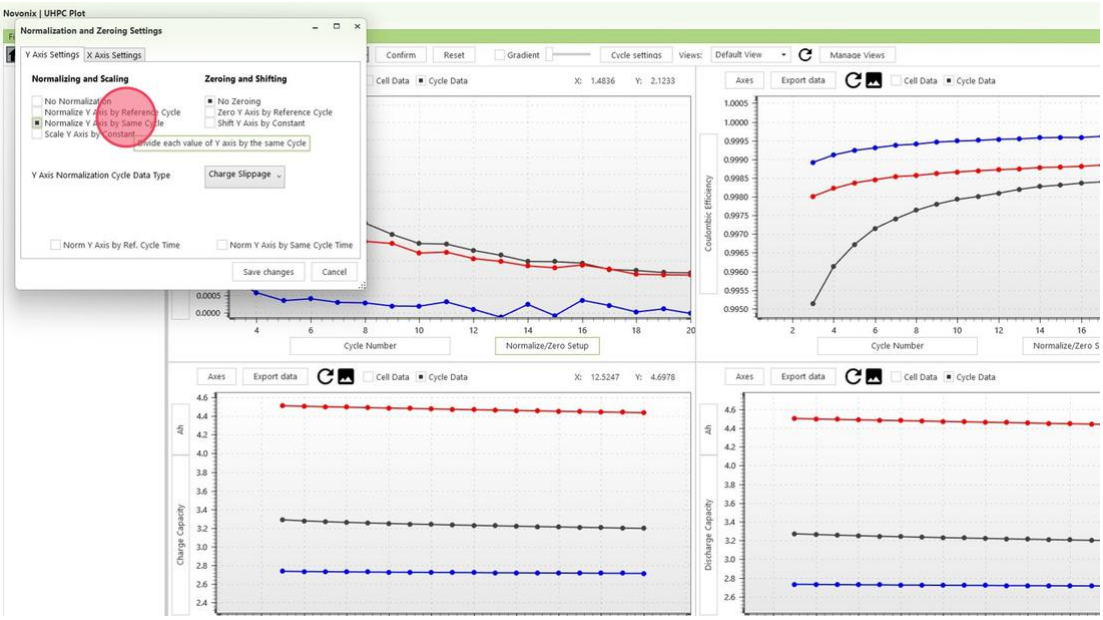
3.4 How to Normalize Charge Slippage by Cell Capacity

1. UHPC Software- How to Normalize Charge Slippage by the Capacity of the Cell in UHPC Plot This guide provides a method for normalizing charge slippage relative to cell capacity in UHPC plot, enabling users to gain a clearer understanding of performance metrics. Users can effectively visualize charge slippage as a proportion of charge capacity, facilitating better analysis and decision-making. Set "Charge Slippage" as the Y-axis and plot it against "Cycle Number" on the X-axis. In this example, I'm analyzing three cells and focusing on cycles 3 through 20.

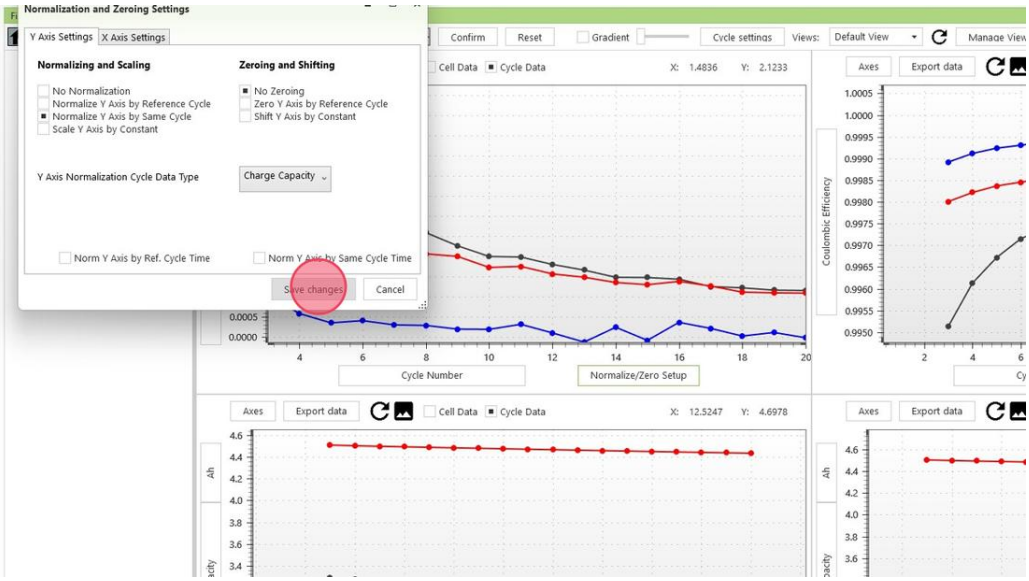


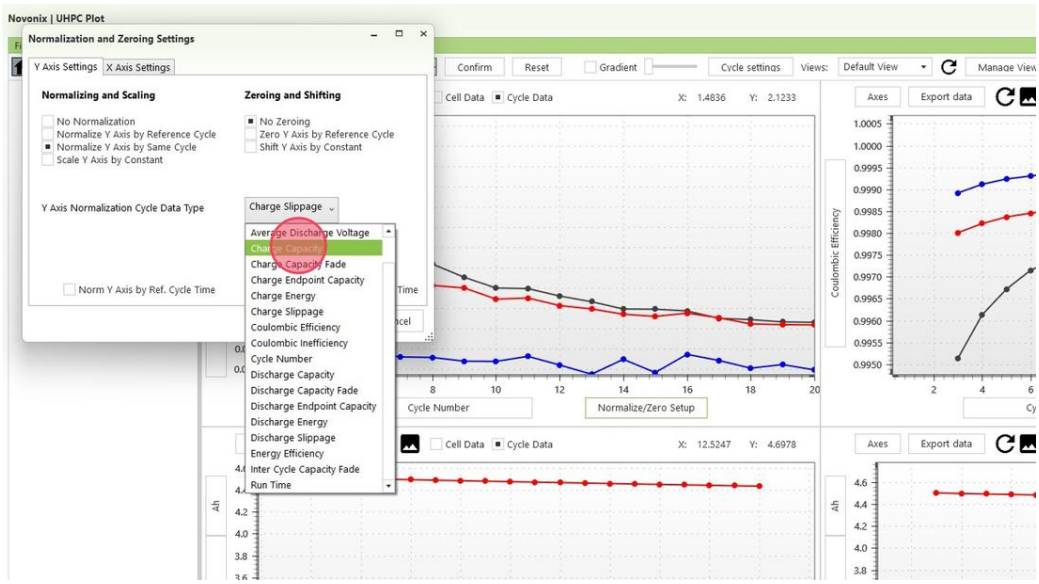
2. Click "Normalize/Zero Setup" Click "Normalize Y Axis by Same Cycle" to normalize the Charge Slippage data relative to the data from the same cycle. In this case, we're interested in understanding what portion of the cell's capacity is affected by the Charge Slippage. The cells capacity will degrade with each cycle.



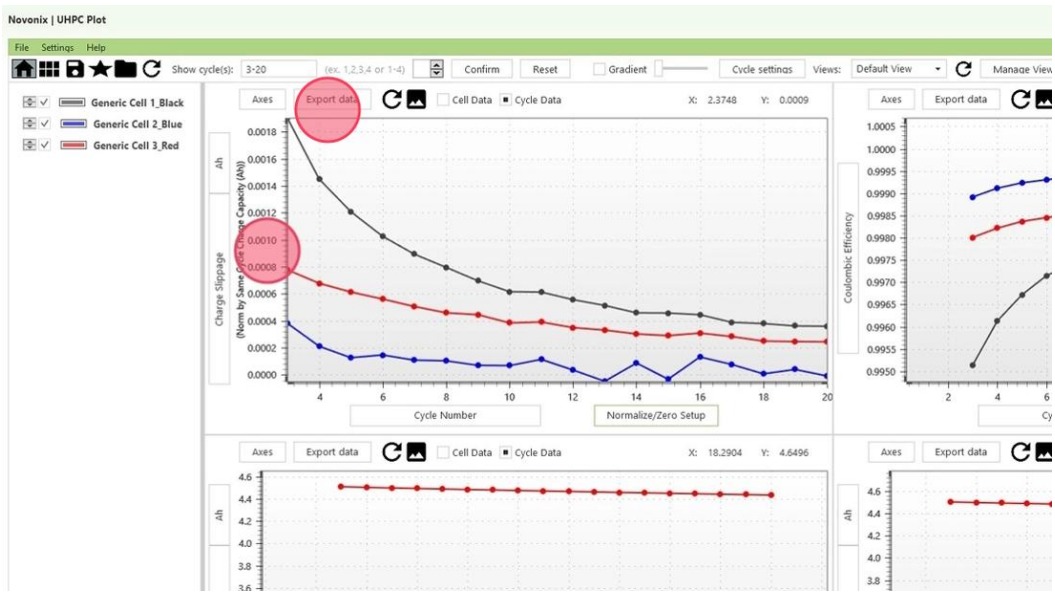


3. Click "Charge Capacity" to normalize against, so that Charge Slippage is displayed as a proportion of the cell's charge capacity. Click "Save changes"





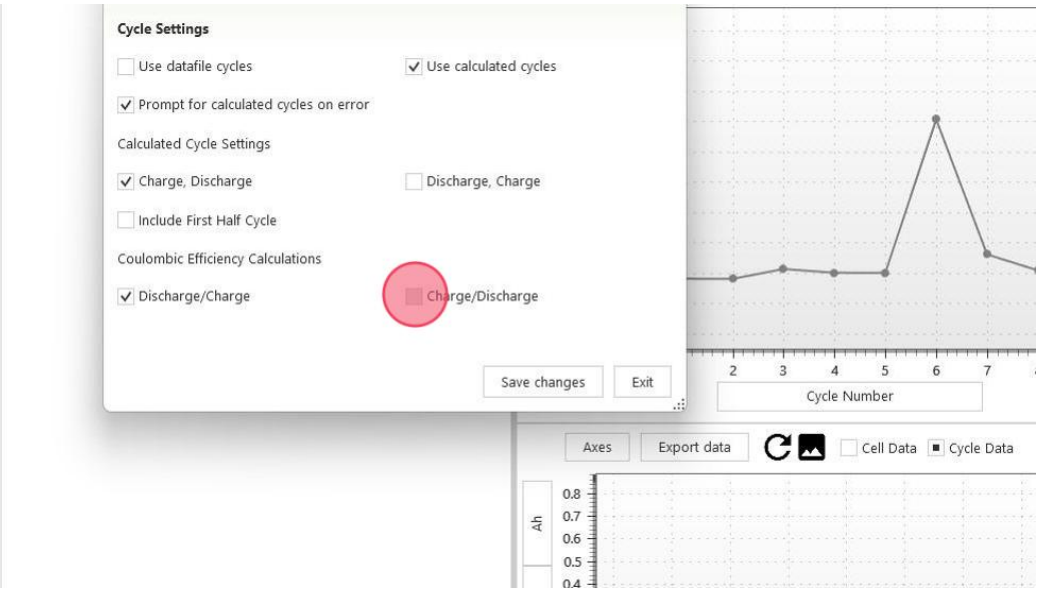
4. You should now see Charge Slippage as a portion of each cell's Charge Capacity — a more accurate way to analyze charge slippage. If needed, you can export the data and perform additional calculations to graph the slippage as a percentage relative to charge capacity.

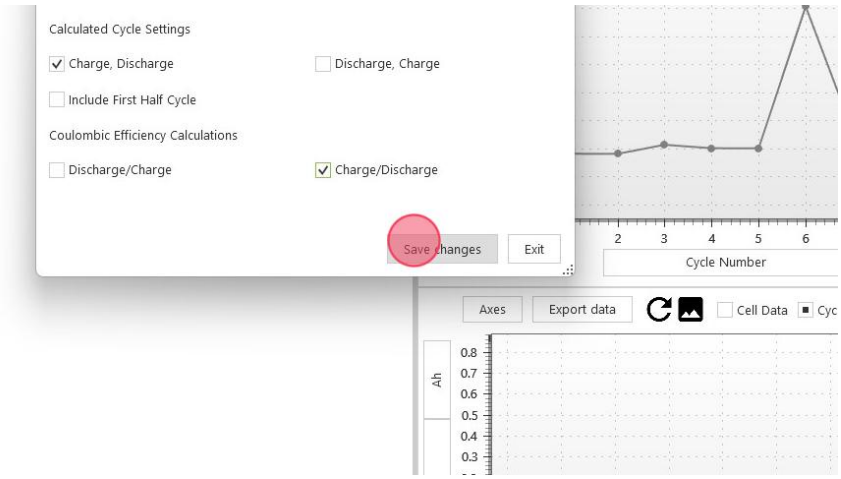


3.5 How to Adjust Cycle Settings for Anode Half Cells CE Data

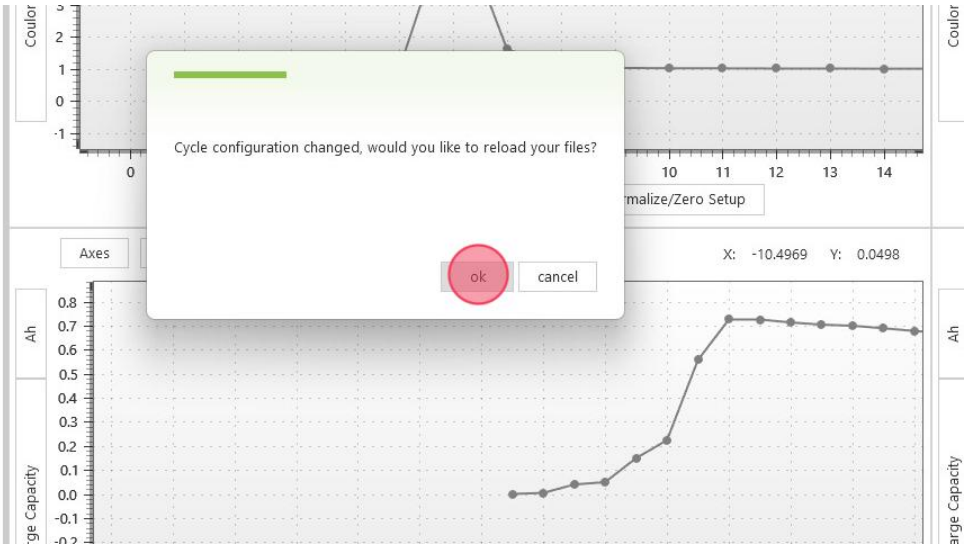
1. UHPC Software- How to adjust Cycle Settings for Anode Half Cells CE Data in UHPC Plot This guide provides a step-by-step process for adjusting cycle settings for Anode half cells CE Data in UHPC plot software. By default, our cycle settings are configured for Full cells and/or Cathode half cells CE Calculations.
2. Click "Cycle settings" in UHPC Plot Software.

3. By default, our Coulombic Efficiency calculations are configured for Full cells and/or Cathode half cells. Click the "Charge/Discharge" box under Coulombic Efficiency calculations to toggle ON for Anode half cells. Click "Save changes"





4. If you have data already plotted, click "OK" and it will process the adjustment and re-plot your data. You should now be able to see accurate CE data for your Anode half cells.

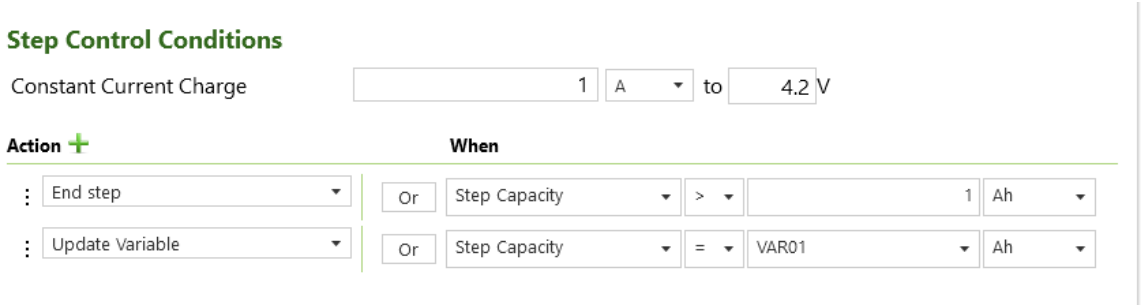


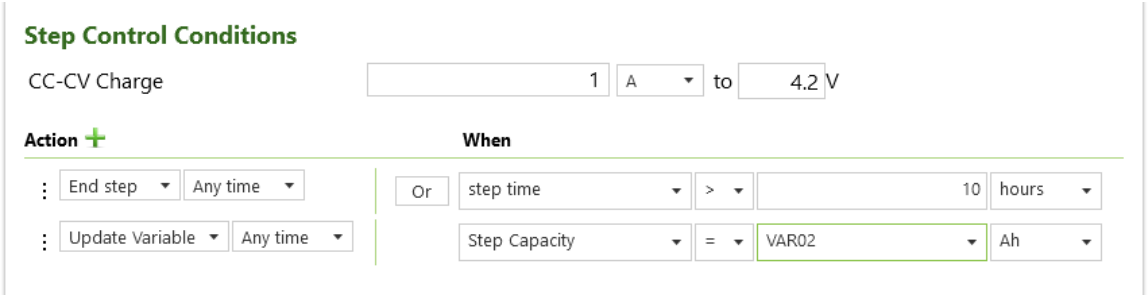
4. Software — UHPC Protocol

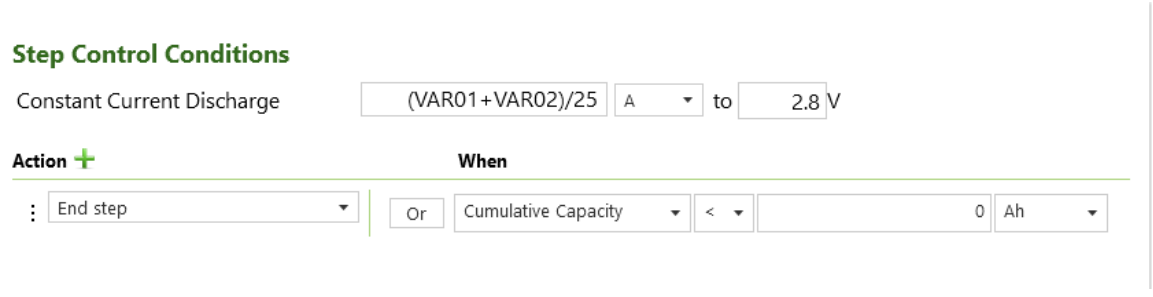
This section covers guides for the UHPC Protocol software application, including using custom variables, built-in variables, and creating incremental cycle counters.

4.1 Getting Started with Custom Variables and Functions

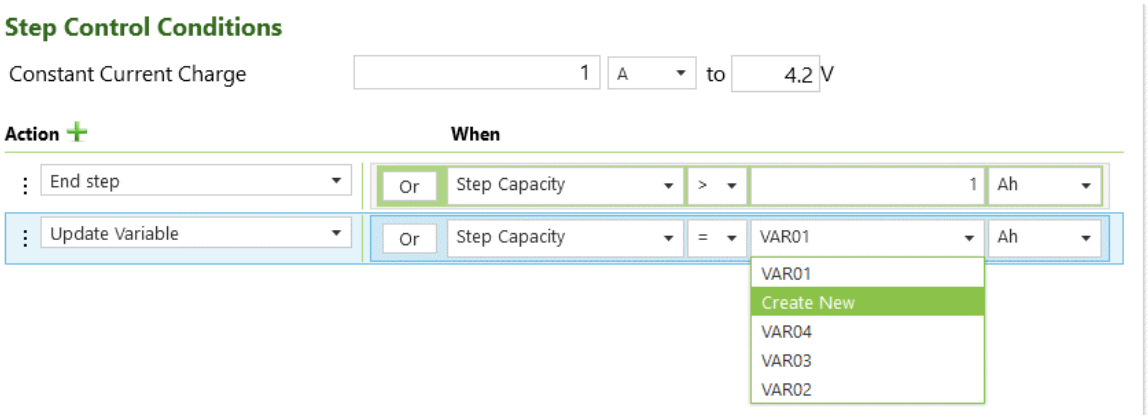
1. As of v2.6.0, UHPC Protocol supports creating and updating variables to trigger conditions within the ‘Step Control Conditions’ text boxes, as well as the ‘Current’ text box. Example use Users may wish to define Step Capacity as a variable rather than a static definition. In the example below, a 3-step protocol runs a CC charge, CC-CV charge and a CC discharge with variable step capacities:
2. Step 1’s Step Capacity is saved to VAR01 Step 2 Step 2’s Step Capacity is saved to VAR02 Step 3 Step 3 uses VAR01 and VAR02 (previous step capacities), to emulate a C/25 charge rate Throughout Step 1 and Step 2, Step Capacity is saved to VAR01 and VAR02 respectively.
3. When Step 3 is executed, the Current equation uses custom variables to mimic “C/XX” where XX is 25, and C is the step capacity saved in step 1 and 2 as VAR01 + VAR02.





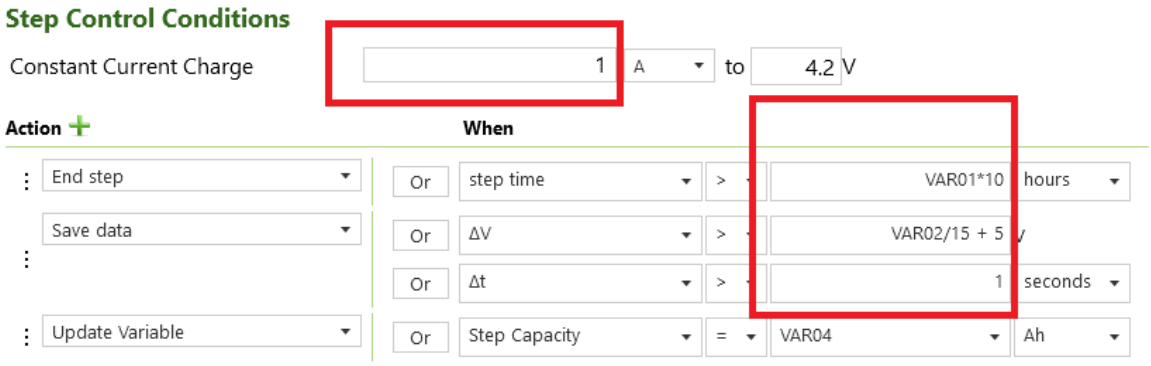


4. Note Keep an eye on your units. UHPC Protocol will convert all values to root units before saving.
5. For example, in the example below for a 1Ah charge. VAR01 would be saved as 1 and VAR02 would be saved as 1000. Which could result in a 1mA charge in the first image below, but an attempt to charge at 1000A in the second image below! New Custom Variables To create new variables, or overwrite an existing variable, select “Create New”, or select an existing variable from the “Update Variable” dropdown menu: When “Create New” is selected, a textbox appears. All variables must contain at least one letter and no spaces.
6. They should not contain other variable names. The list of newly created Custom Variables will be erased upon closing UHPC Protocol. To persist Custom Variables, create them as part of the Default Configuration.



7. Available Custom Variables will also be loaded into the session when Protocols with existing Custom Variables are loaded.
8. Note Custom Variables do not need to follow the VAR01, VAR02, VARXX naming conventions. Users are free to define more intuitive names – STEP1CAP, STEP2CAP etc. Custom Expressions Additionally, right-side conditions and Current may be represented with a function containing variables to be executed in real time. Voltage custom expressions are valid as of UHPC Control 2.8.0.

9. Custom Expressions are intended to be used with Custom Variables but can also be used to execute simple algebra. The following are all valid expressions: 2 + 15 + 5 2+10/(15+5) $VAR01$ + 0.01 × $VAR02$ × 8 12 + 7 VAR01 +(0.01*VAR02*8)/(12 + 7) $VAR01$ $VAR03$ VAR01/VAR03 - 5 $VAR01$ $VAR04$ + 9 VAR01/(VAR04 + 9) The expression below will be evaluated at the start of the step execution for Current, and throughout the step for End/Save Step Conditions:
10. Note that in some cases, expressions cannot be evaluated. For example, some variables may grow to illegal values over the course of a test. Depending on where the expression is called, UHPC Protocol manages these exceptions.

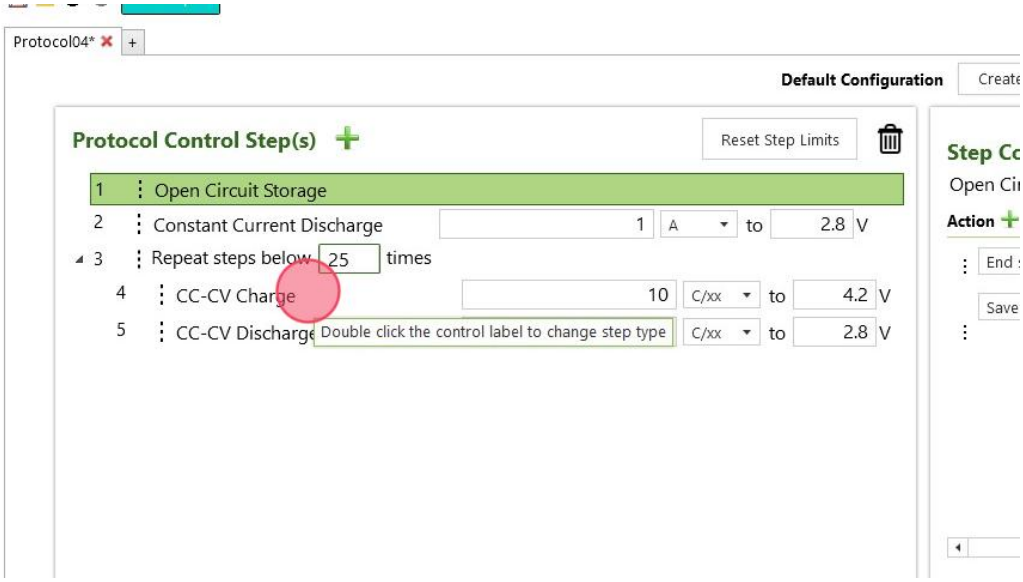


11. In cases where expressions cannot be evaluated: In the case of current: o The test will halt in an error state In the case of a right-side condition: o The test may continue while logging errors of which condition could not be evaluated. This may result in steps running past their end conditions Info Longer variable names or expressions require more width and may reduce readability in the program GUI. If you are struggling to read or write the full expression, you may copy/paste the expression with the help of Notepad. If Protocol refuses to paste, your expression likely contains illegal characters.

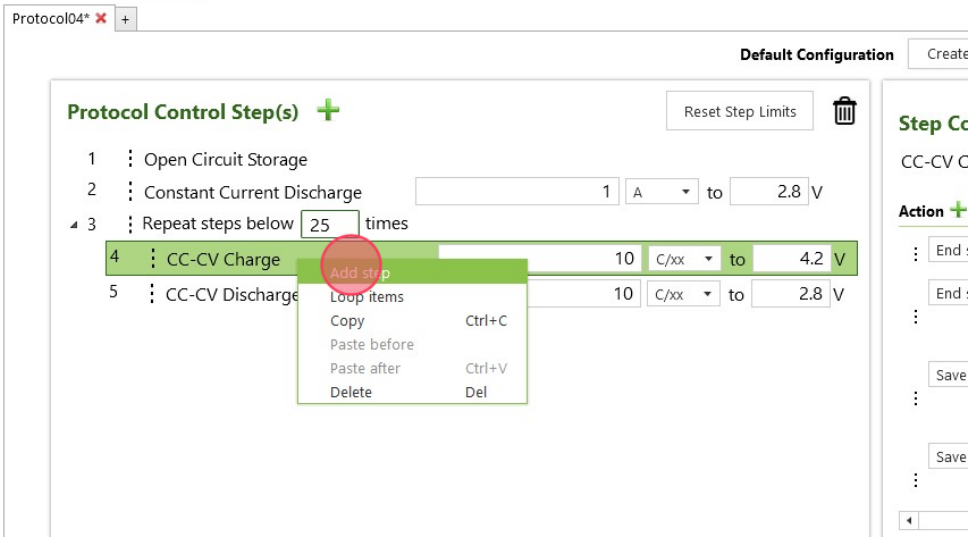
12. Remember that only alphanumeric characters and basic math evaluators are allowed, 0-9A-Z,./*()+-^. Reducing complexity reduces chances of error. The logic in the code follows the BEDMAS order of operation, after replacing all variables with numbers. Info Custom Expressions also support some math functions such as: log(y,x) -- Base y ln(x) -- base e lg(x) – base 10 exp(x) – e^x abs(x) cos(x), sin(x), tan(x), cot(x), sec(x) To use math functions, just include them directly in the text box, they will be evaluated at run time. Try to avoid using custom variables with names that may conflict with any math functions you use.

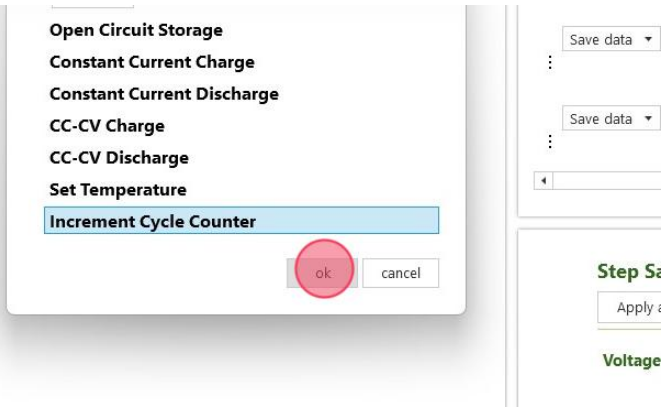
4.2 How to Add an Incremental Cycle Counter

1. UHPC Software- How to Add an Incremental Cycle Counter in UHPC Protocol This guide provides step-by-step instructions on how to add an incremental cycle counter in UHPC Protocol. It is useful for individuals who want to track and record the number of cycles in their CSV files for further analysis. • Right click within the loop or area where you want to insert the cycle counter.

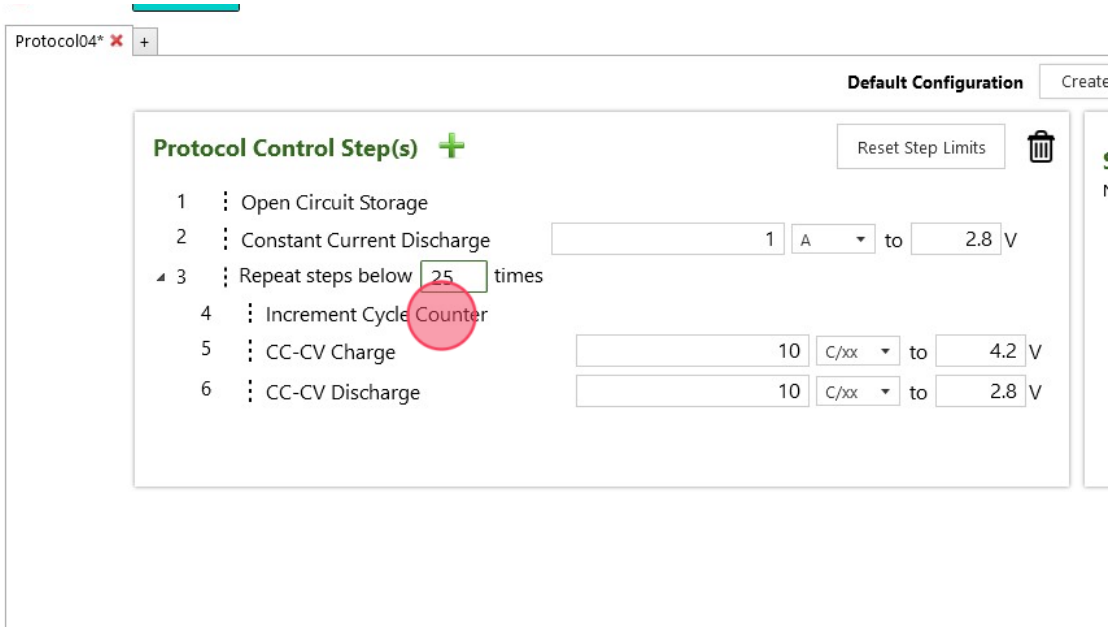


2. Click "Add step" • Select "Increment Cycle Counter" • Click "ok"





3. Drag "Increment Cycle Counter" to set the starting point for cycle counting. • In this example protocol, 25 cycles will be counted. • Cycle 1 will record Constant Current Discharge Data only. • Cycles 2-25 will involve CC-CV Charge/Discharge cycles at C/10. Now, you'll find cycle number data in your CSV file when exporting data from UHPC Control.

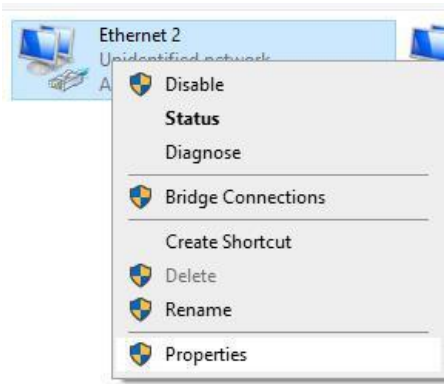


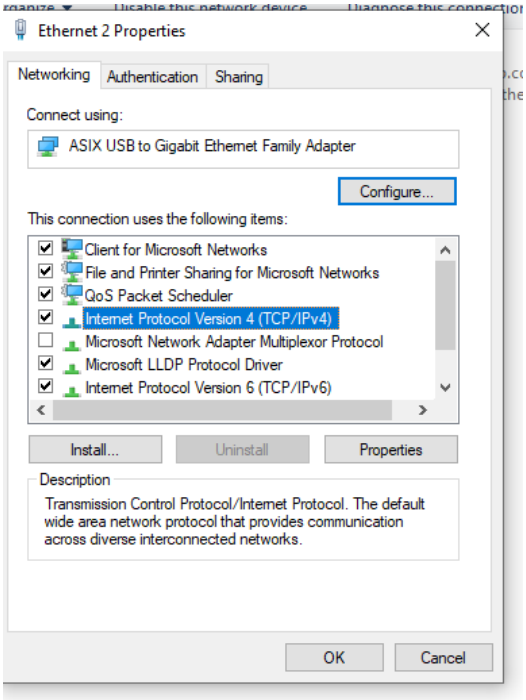
5. Network Connectivity

This section covers all guides related to network setup, IP address configuration, and connecting UHPC hardware to new or existing computers.

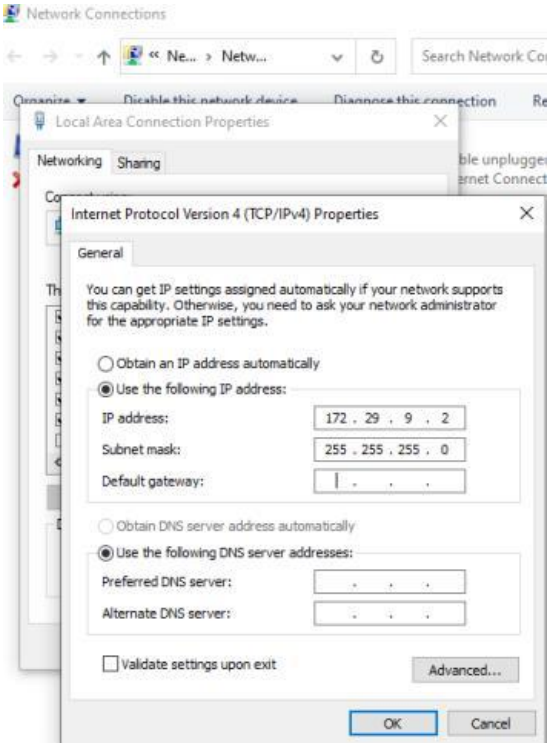
5.1 How to Manually Change IP Address

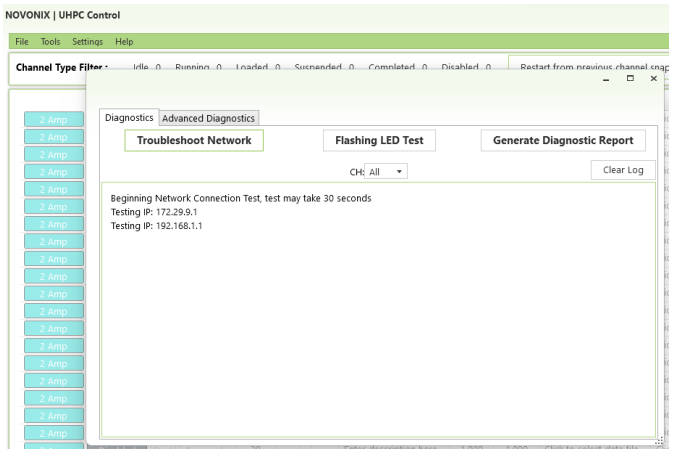
1. 110 Simmonds Drive, Dartmouth Nova Scotia, B3B 1N9 www.novonixgroup.com Manually Change IP Address • In the Windows search bar type "View network connections" and click. • Right click the unknown network (master controller) This is sometimes Ethernet 2. Click Properties. • In properties, click the IPV4





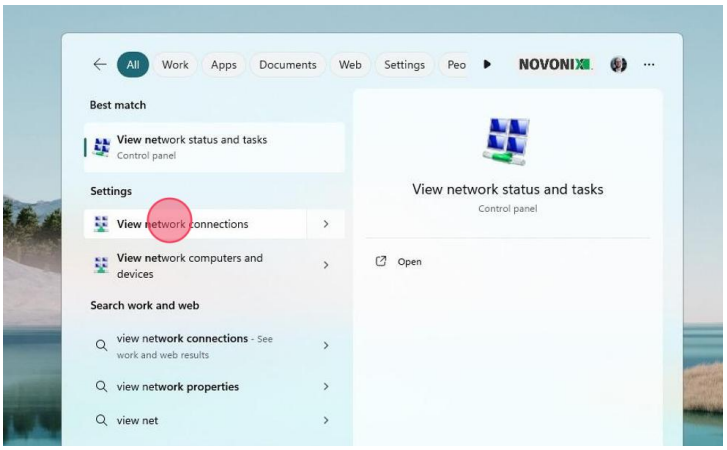
2. • Manually change the IP address in the IPV4 adapter settings and try to connect with “192.168.1.2”. The Subnet mask should be “255.255.255.0” •
3. After changing the IP in network settings for windows in UHPC Control, go to Tools -> Diagnostics and click "Troubleshoot network"
4. If the 192... number does not work after one minute, please try “172.29.9.2” as the IP address.
5. Depending on the age of your system, one of these IP addresses should establish a connection.



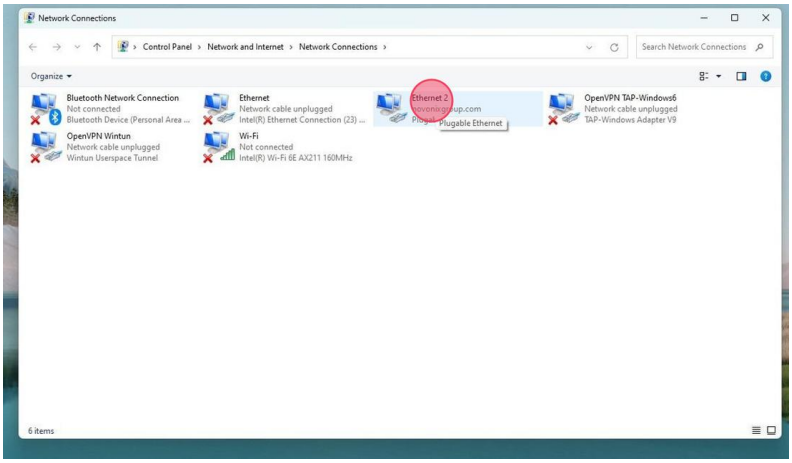


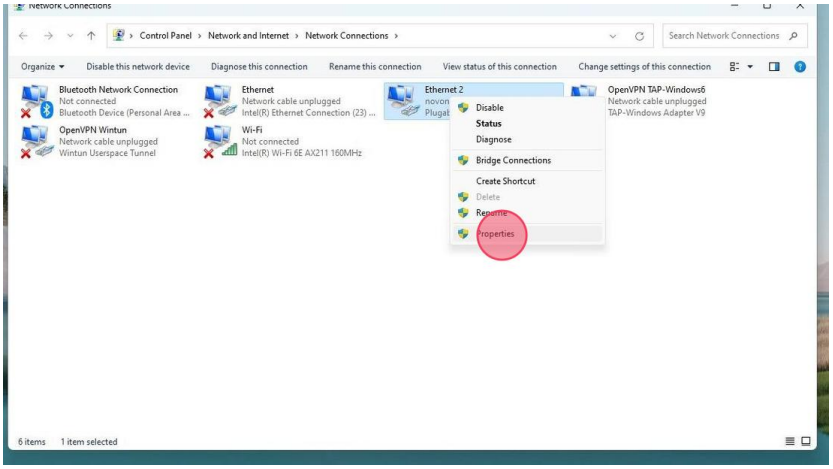
5.2 How to Connect UHPC to a New PC

1. UHPC Hardware- How to Connect to a New PC When connecting UHPC software to a new PC, you are required to manually change the IP address on your PC. This guide shows the steps required to establish a connection.
2. Click Windows search bar, and search "View Network Connections" • Click "View Network Connections"

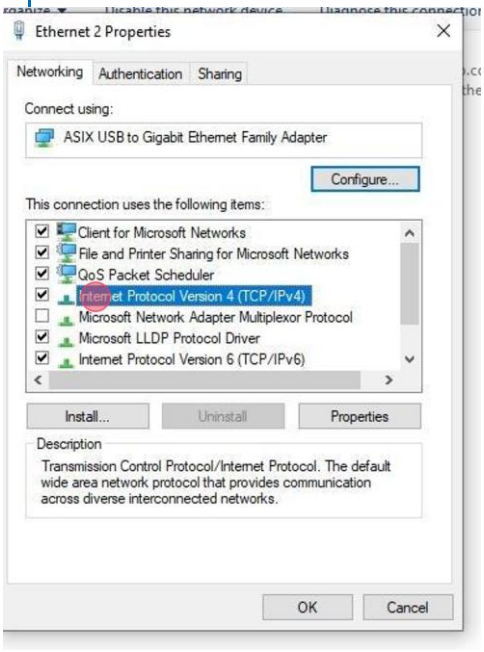


3. • Right click the unknown network (Controller Module). • This is sometimes 'Ethernet 2.' Click "Properties"

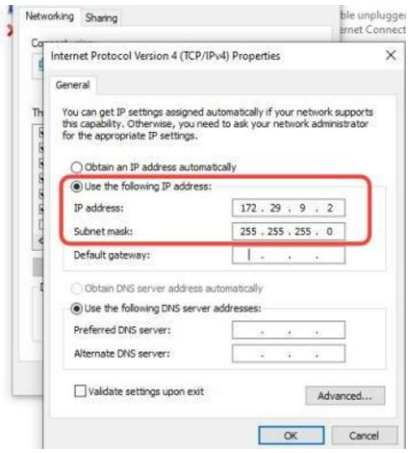




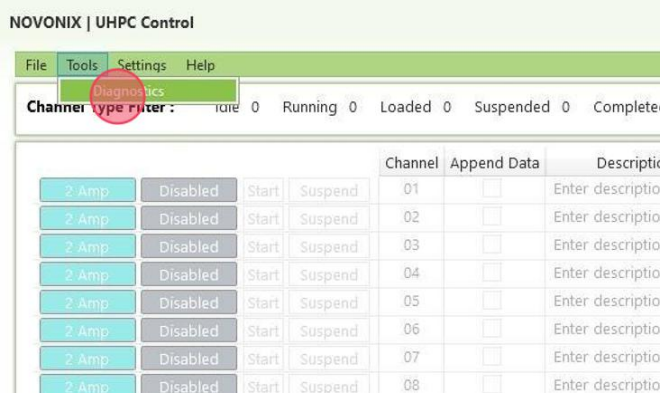
Tip: Some companies require IT permissions to modify "Network Connections" Double Click "IPV4"



4. • Manually change the IP address in the IPV4 adapter settings to “172.29.9.2” • Change the Subnet mask to “255.255.255.0” The above windows may look different depending on the Microsoft Software Version you have installed.



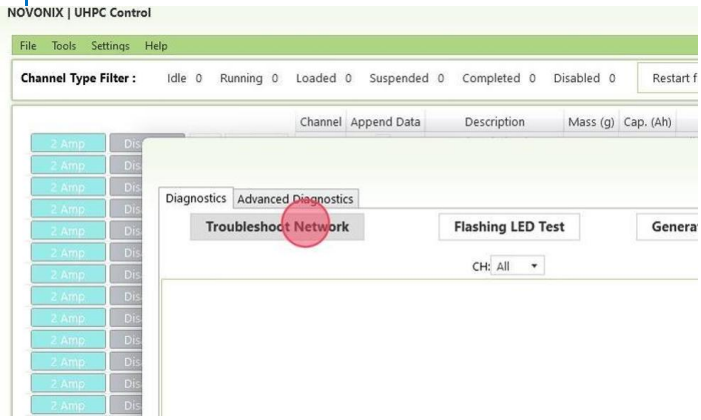
5. • After changing the IP Address in Network Connections. • Open UHPC Control Software. • Click "Tools" and "Diagnostics"



6. • Click "Troubleshoot Network." • You should have established a connection 168.1.2" in Step 5 for the IP address and repeat process.

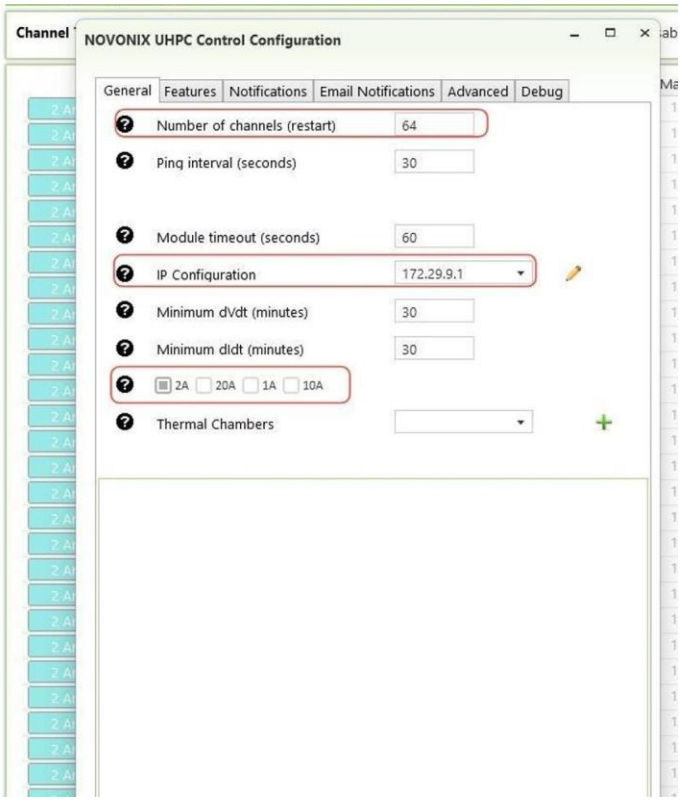
⚠ **Alert:** If connection is not established, try "192.

Tip: If after completing these steps, a connection to your new PC is not established.



5.3 Migrating UHPC to a New Computer While Running Tests

1. UHPC Hardware- Migrating UHPC to a New Computer while running Tests This guide is used to transition UHPC testing hardware to a new computer , ensuring that all settings and data are accurately transferred seamlessly. It covers setting up the new PC, migrating necessary files, and configuring network settings, which are crucial for maintaining continuity in testing.
2. On the Old Computer: • Open UHPC Control, click "Settings", and click "Startup Configurations" • Record the IP Address and startup configurations



3. On the New Computer: • Ensure it has the standard Windows 11 or Windows 10 build • Update to the latest version if the PC is connected to the internet • Install the latest UHPC Software (Control, Plot, Protocol) which can be found at [Customer Area - NOVONIX (novonixgroup.com)](https://www.novonixgroup.com/customer-area/)

> **Tip:** If your new computer is not connected to the internet, you can download the above UHPC software on a dongle or a USB flash drive with a computer that is connected to internet

UHPC Control

Software Download (v2.8.6) | Release Notes

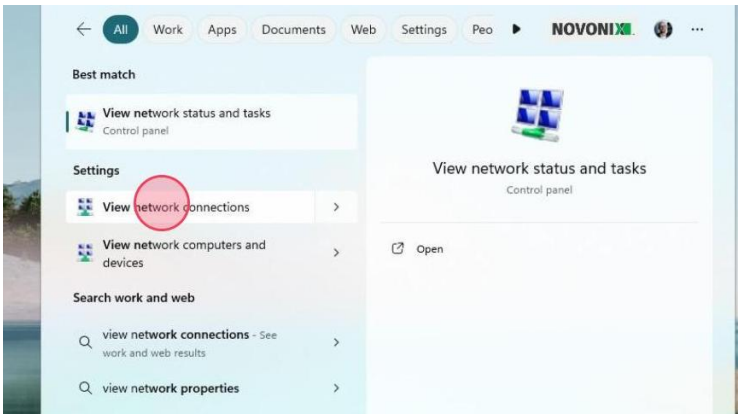
UHPC Protocol

Software Download (v2.7.6) | Release Notes

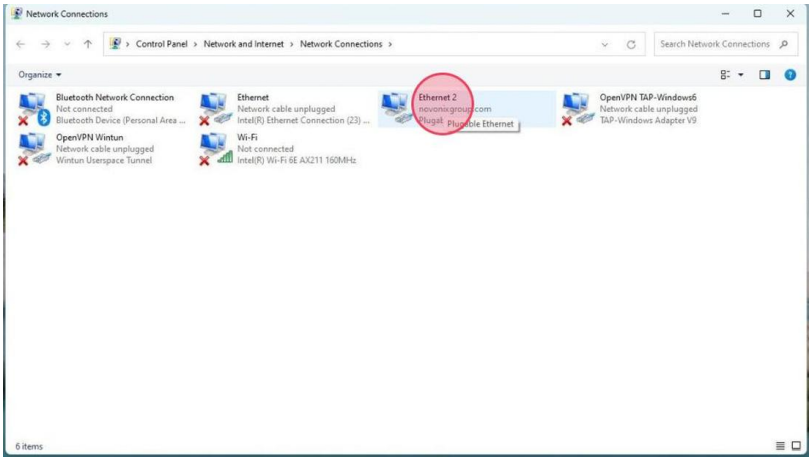
UHPC Plot

Software Download (v2.11.0) | Release Notes

4. On the New Computer Manually change the IP address: • Click Windows search bar, and search "View Network Connections" • Click "View Network Connections"



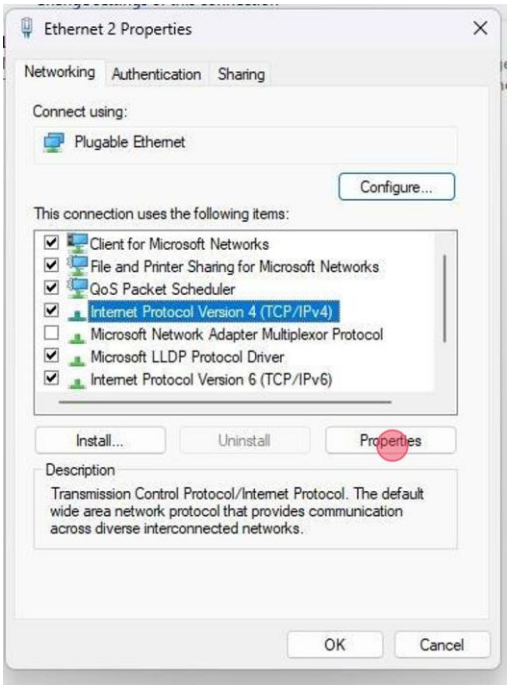
5. On the New Computer Manually change the IP address: • Right click the unknown network (Controller Module) • This is sometimes 'Ethernet 2.'



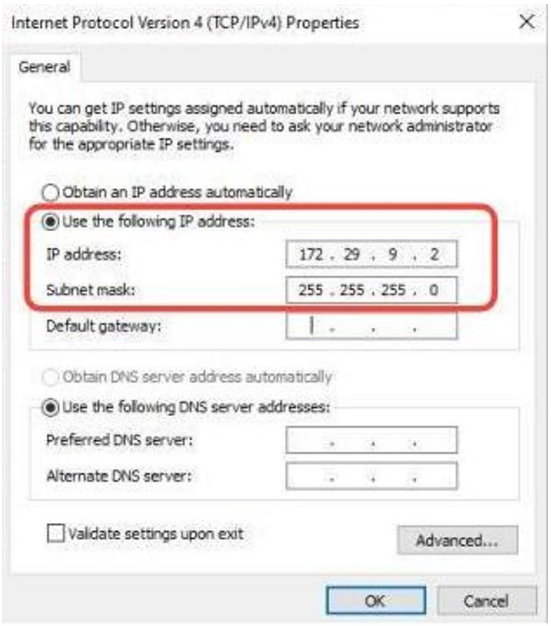
6. On the New Computer Manually change the IP address: • Click "Properties"

Tip: Some companies require IT permissions to modify "Network Connections"

7. On the New Computer Manually change the IP address: • Click "IPV4" so that its highlighted in blue • Click "Properties"

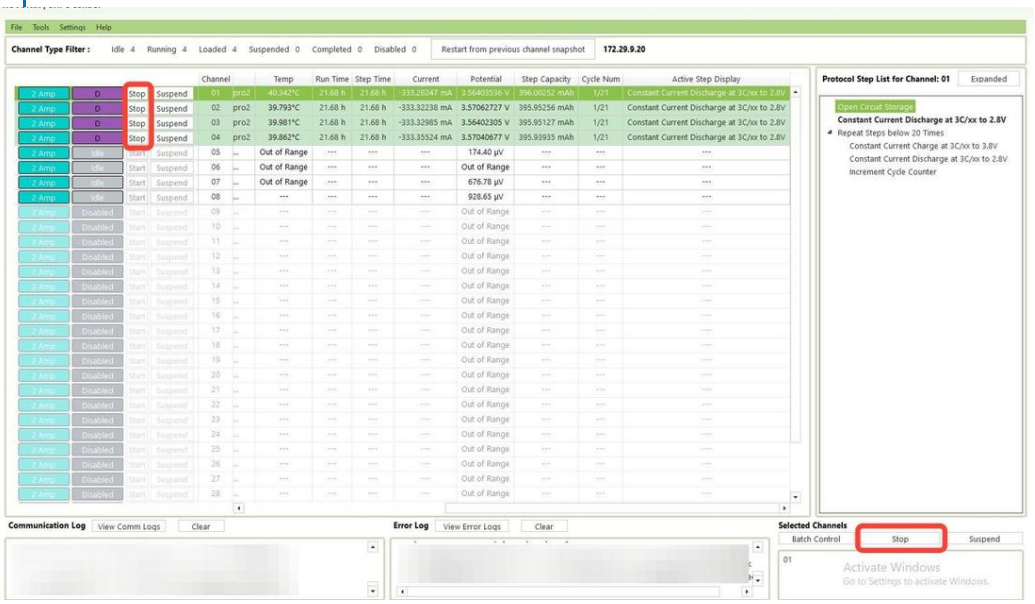


8. On the New Computer Manually change the IP address: • Manually change the IP address in the IPv4 adapter settings to match your UHPC IP configuration.
9. If your IP configuration in Step 1 is "172.29.9.1," set the IPv4 adapter to "172.29.9.2" The last digit should always be one number higher than your UHPC IP configuration. • Change the Subnet mask to “255.255.255.0” • Click OK and save settings



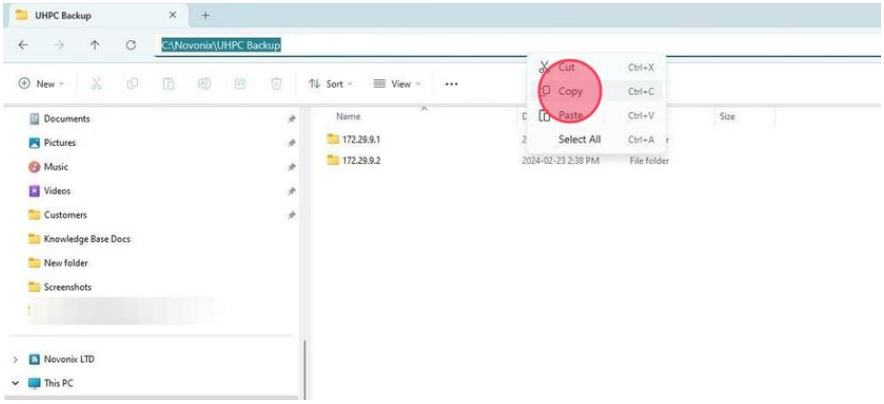
10. On the Old Computer: • Within your UHPC Control Software, Click "Stop" on all individual channels that tests are running • Alternatively, select all running channels and click "Stop" in the bottom right hand corner. • Once your Channels are Stopped. Shutdown the UHPC Software by clicking "X" in the top right hand corner.

> **Tip:** Steps 9 and 10 are crucial to follow exactly for a seamless transfer



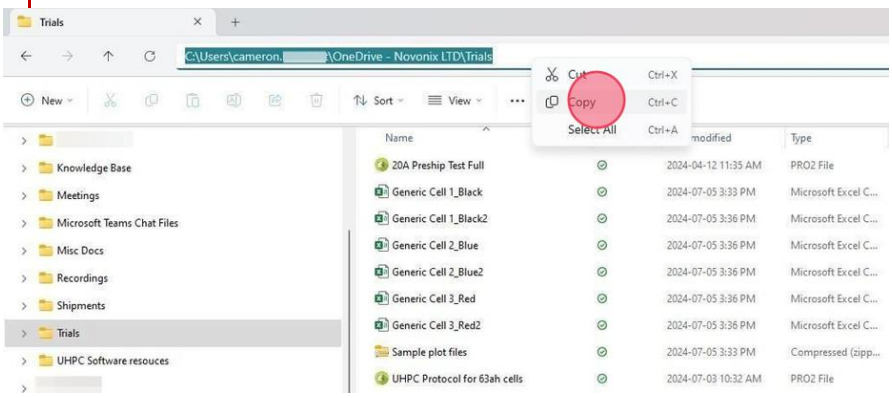
11. Migrate Files from Old Computer to New Computer: • Copy the UHPC Backup and DataSnapShot folders from C:\Novonix on the old computer.

12. Transfer these 2 folders to the new computer, keeping the same path ("C:\Novonix") via USB, cloud storage, or other methods • Use "Copy" (e.g., "C:\Novonix\UHPC Backup") to ensure the path is labeled correctly on the new computer.



13. Migrate Files from Old Computer to New Computer: • Copy the Protocol Files and Data Files folders from old computer or wherever they are located.
14. To restore snapshots seamlessly, ensure the Protocol Files and Data Files folder structures on the new computer exactly match those on the old computer. Transfer these folders to the new computer via USB, cloud storage, or other methods
15. For example, if your data files were saved to "C:\Users\cameron\OneDrive - Novonix LTD\Trials" on the old computer, use the same path on the new one. Use "Copy" to ensure the correct path is transferred.
16. In this example, both Protocol Files and Data Files are saved in the same folder. You will have to do this step for each folder you have your Data Files and Protocol Files saved to. If the folder structure doesn't match, each snapshot will need to be updated manually. Even if "cameron" no longer exists as a user, it's recommended to replicate the original path to avoid issues.

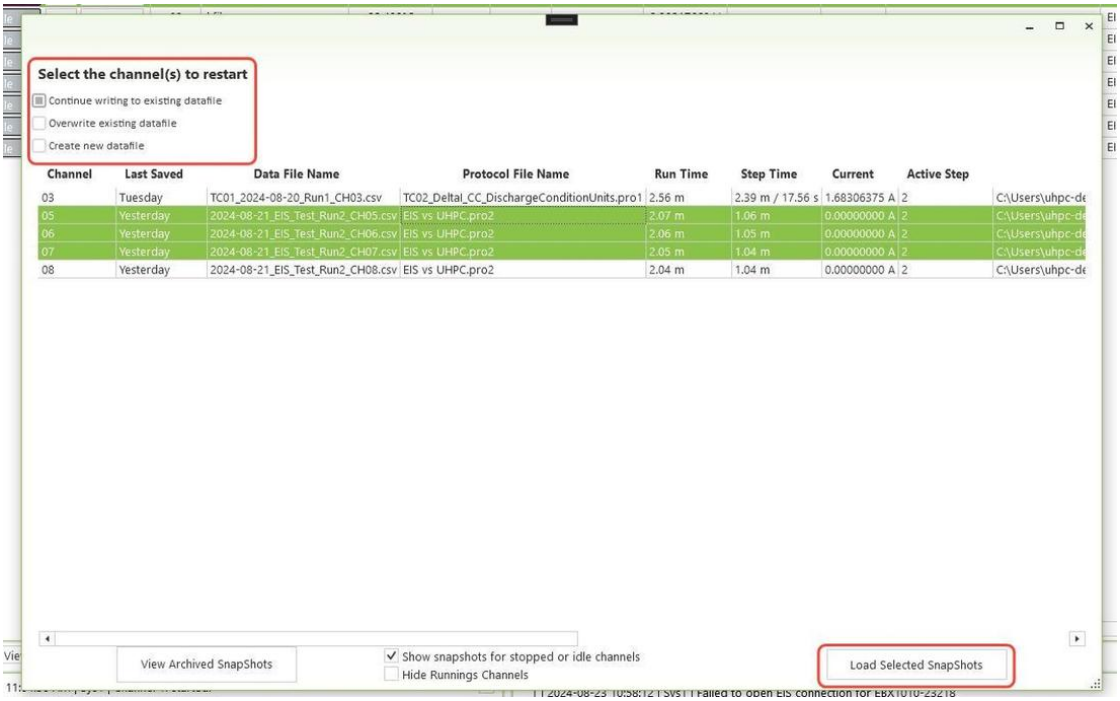
> ⚠ **Alert:** for Steps 9 & 10!



17. Connect New Computer to Your UHPC Hardware • Unplug the Ethernet cord from your old computer • Connect the Ethernet cord to your new computer • Open the UHPC Control Software, you should have established a connection • Input the Startup Configurations you recorded in Step 1

⚠ **Alert:** If connection was not established, check the IP Configuration on New computer and review step 7

18. • From UHPC Control Click "Restart from previous channel snapshot." • Select the tests you want to restart by choosing the relevant channels (hold "Ctrl/Shift" to select multiple) • Indicate where to store the new data by checking the appropriate box. By default, data will be written to the existing data file. • Click "Load Selected SnapShots" to proceed. com for help manually transferring your datafiles and protocols.

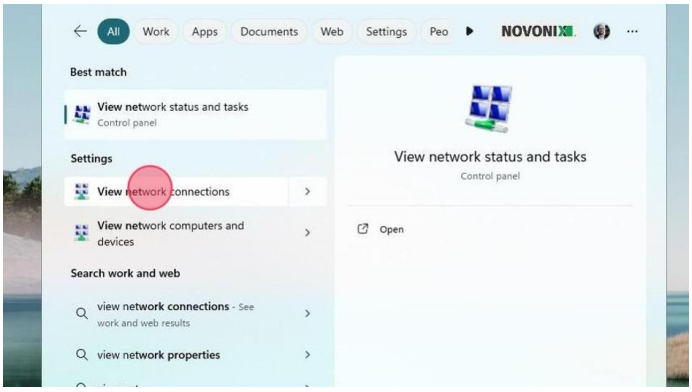


5.4 Configuring an IP-Enabled Thermal Chamber to an Existing PC

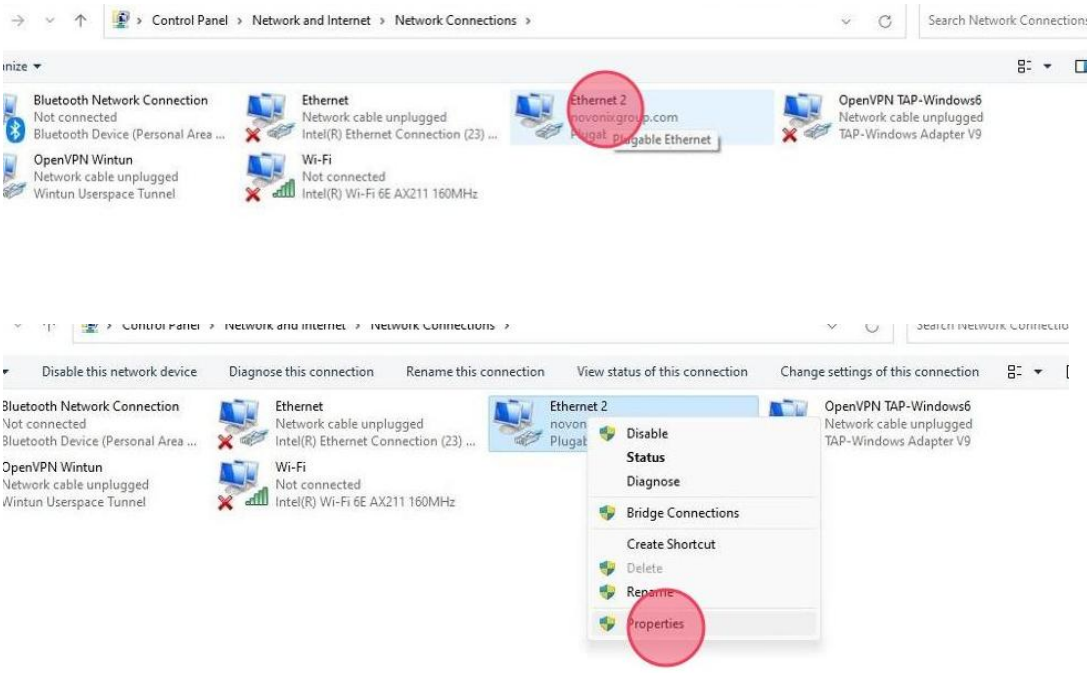
1. UHPC Hardware and Software: Configuring an IP-Enabled Thermal Chamber to an Existing PC This guide is for integrating an IP-Enabled thermal chamber with an existing PC, ensuring proper connectivity and functionality. It provides step-by-step instructions to connect the chamber hardware, configure IP settings, and establish a software connection with the UHPC control software.
2. Connect the Thermal Chamber to the UHPC PC: • Ensure you are at the correct chamber. • Ensure the Ethernet cord from the Chamber is plugged into the UHPC PC. • Plug the Chamber power supply into the UPS. • Turn ON the Chamber power switch. If your UHPC PC lacks an available Ethernet port, we recommend using a Network Switch to connect your PC and Ethernet cable.

> **Tip:** If you have multiple thermal chambers, this setup (Steps 2-6) needs to be done once for all thermal chambers connected to that switch.

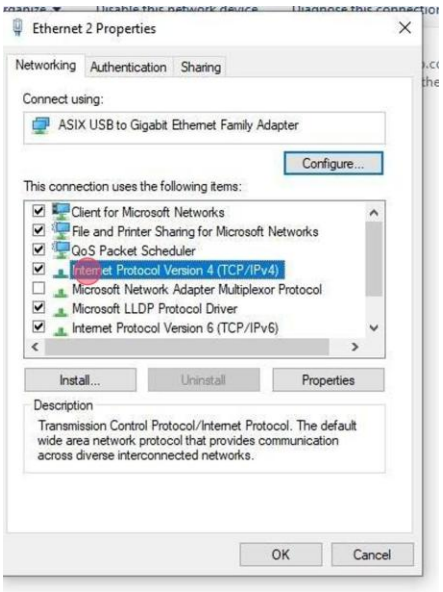
3. From your UHPC PC Desktop: • Click Windows search bar, and search View Network Connections. • Click View Network Connections.



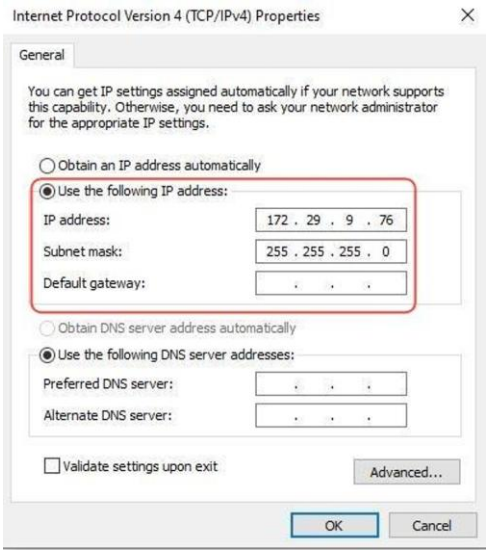
4. • Unplug and reconnect the Ethernet cable to confirm the correct network to be modified (often Ethernet 2 or Ethernet 3). • Right-click the Unknown or Unidentified Network identified as the new Thermal Chamber. Click Properties.



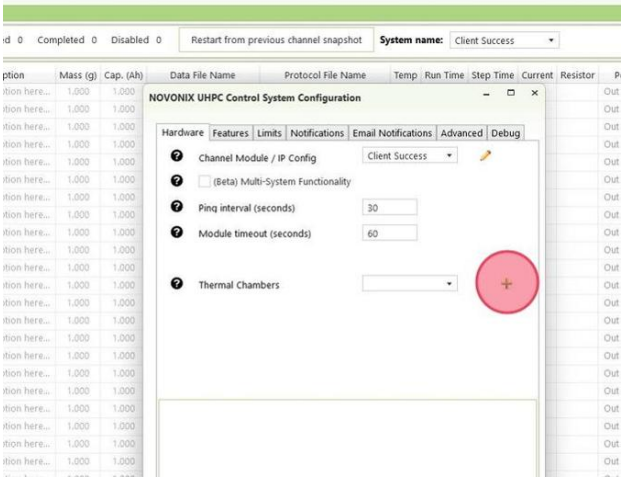
5. Double Click IPV4.



6. Manually change the IP address in the IPV4 adapter settings to 172.29.9.76 • Change the Subnet mask to 255.255.255.0 • Click OK. • Save and Exit.
7. Please ensure the IP addresses are entered exactly as shown: IPv4 on your PC: 172.29.9.76 If you have multiple thermal chambers, assign the next IPv4 address as follows: • Second thermal chamber: 172.29.9.77 • Third thermal chamber: 172.29.9.78 • Continue incrementing for additional chambers.

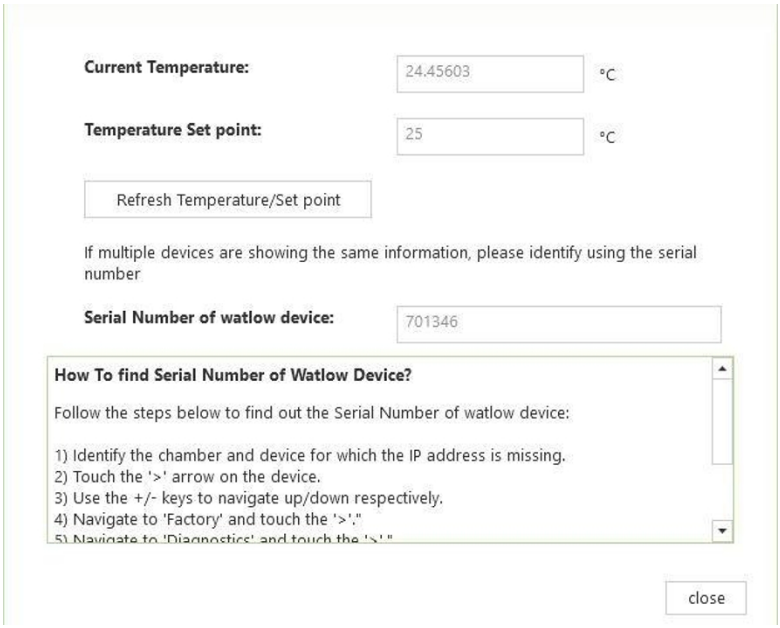


8. Open UHPC Control: • Navigate to Settings, then Startup configuration. • Click the Green + button, to add your IP Address.

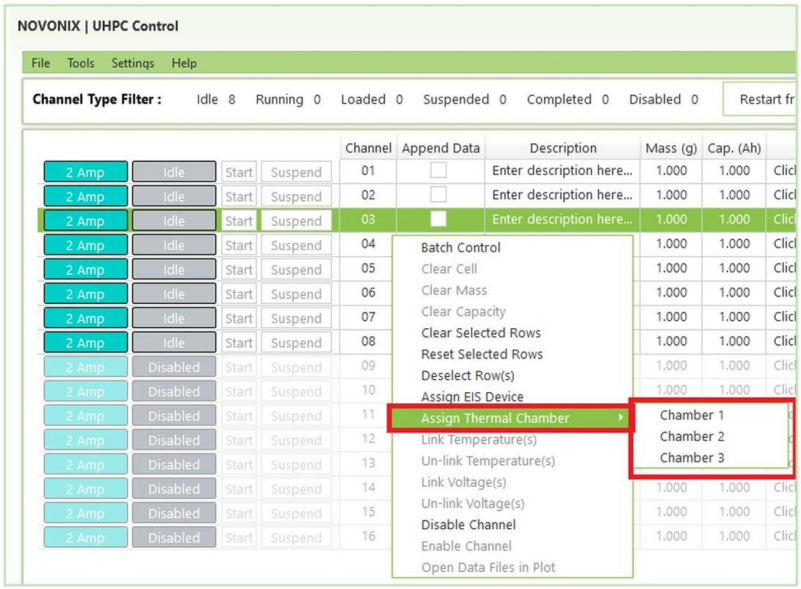


9. From Watlow Configuration: • Enter a name for your Chamber, in the Chamber Name: text box. • Enter the IP address 172.29.9.50 in the Temperature Controller Device IP: text box. • Click the Detect Device button.
10. Please ensure the IP address is entered exactly as shown: Temperature Controller Device IP: 172.29.9.50 If you have multiple thermal chambers, assign the next IPv4 address as follows: • Second thermal chamber: 172.29.9.51 • Third thermal chamber: 172.29.9.52 • Continue incrementing for additional chambers.

11. From Watlow Configuration: • You will receive a popup with your Watlow device and its unique serial number. • Close popup. • Save Startup configuration Changes and Exit. com for further instructions.



12. From the main UHPC Control channel grid: • Right click on the channel(s) you wish to have associated with the chamber. • Click on Assign Chamber to select the chamber name that has been set previously. • You can choose to display the Chamber name and Chamber Temperature column in the UHPC channel grid.
13. You should now be connected to your new Thermal Chamber and able to use Temperature Step conditions in the UHPC protocol successfully.


NOVONIX | UHPC Control
File Tools Settings Help
Channel Type Filter : Idle 8 Running 0 Loaded 0 Suspended 0 Completed 0 Disabled 0
Restart fr
Channel
Append Data
Description
Mass (g)
Cap. (Ah)
2 Amp
Idle
Disabled
Start
Suspend
01
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
Enter description here...
1.000
Batch Control
Clear Cell
Clear Mass
Clear Capacity
Clear Selected Rows
Reset Selected Rows
Deselect Row(s)
Assign EIS Device
Assign Thermal Chamber
Link Temperature(s)
Un-link Temperature(s)
Link Voltage(s)
Un-link Voltage(s)
Disable Channel
Enable Channel
Open Data Files in Plot
Chamber 1
Chamber 2
Chamber 3

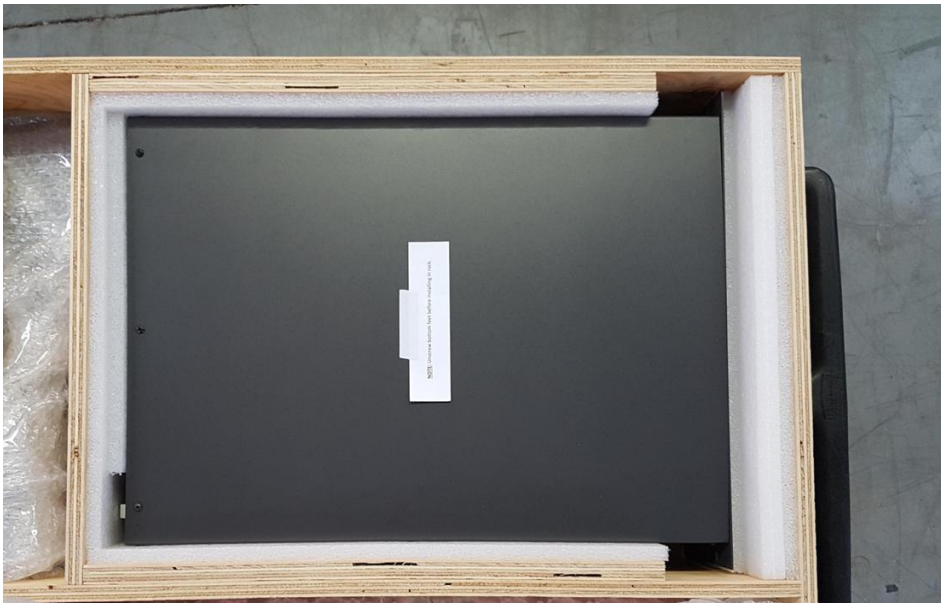
6. Calibration

This section covers all guides related to calibration of UHPC hardware, including shipping, the calibration process, validation mode, and DMM configuration.

6.1 How to Package Your UHPC Channel Module for Calibration

1. How to Package your UHPC Channel Module for Calibration This guide provides step-by-step instructions on how to package your UHPC Channel module for calibration. It includes details on the tools needed, the specific dimensions of the crate, and how to reattach the top panel. It also provides the shipping address and contact information for any further assistance.
2. You will receive a custom wooden crate like the picture below.
3. You will need a drill/impact gun with a Phillips-head attachment to unscrew the top wooden panel. • Unscrew the top panel and place to the side with the screws.

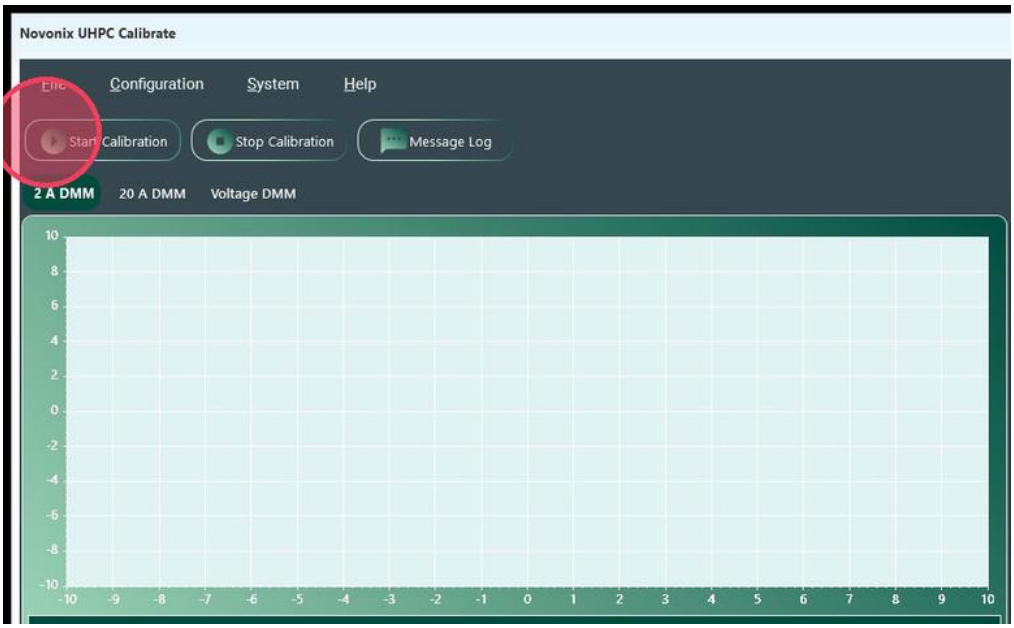
4. In the empty crate, there will be foam adhered to the wooden panels with the specific dimensions of your UHPC Channel module.
5. Carefully place your UHPC Channel module in the crate. The crate will have more space on one end to accommodate the mounting brackets.
6. Please see picture below. For calibration services, no cables or controller modules are required to be packaged.



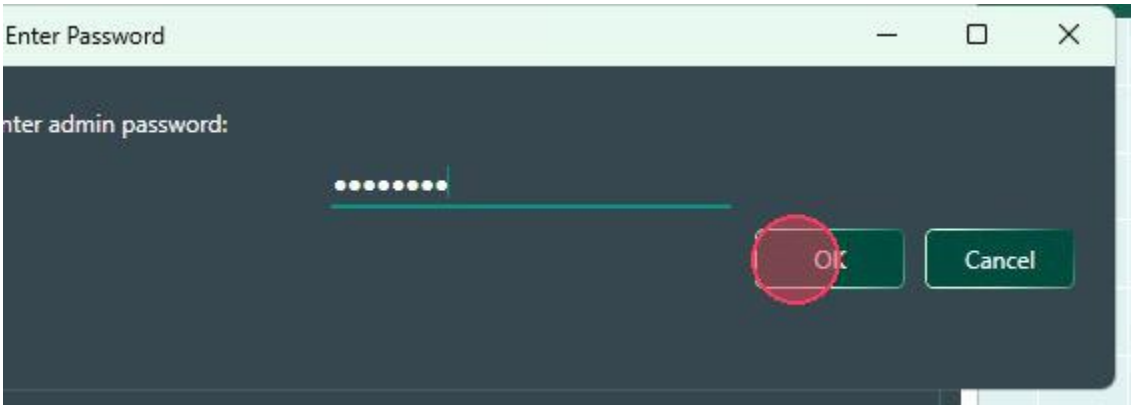
7. • Finally, reattach the top panel of the crate with the same screws that you took off. • You will need a waybill and packing slip in order to ship the crate back .

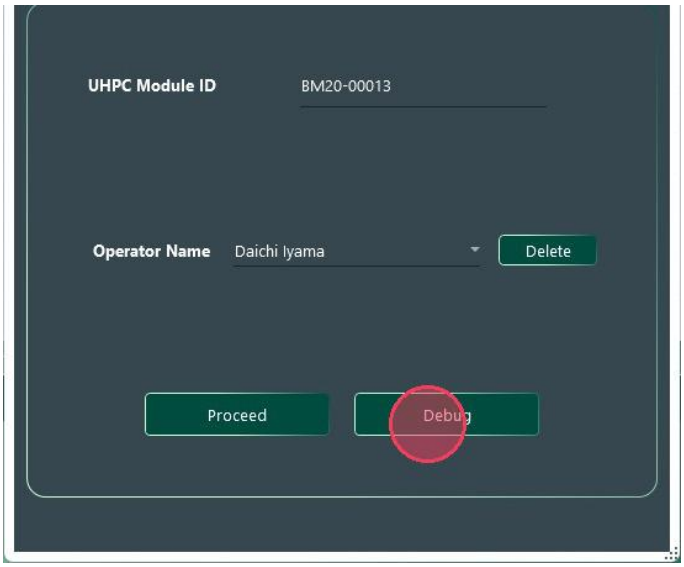
6.2 How to Initiate Validation Mode for UHPC Calibrator

1. How to Initiate Validation for UHPC Calibrator This guide shows how to run a quick Validation of a UHPC channel using the Calibrate software's debug mode to capture "as found" error measurements without performing full coefficient adjustments. The process is roughly 50% faster than full calibration and produces a CSV report for review. Connect your calibrator to the UHPC Channel Module you want to validate.
2. Open the UHPC Calibrate software, then click Start Calibration.

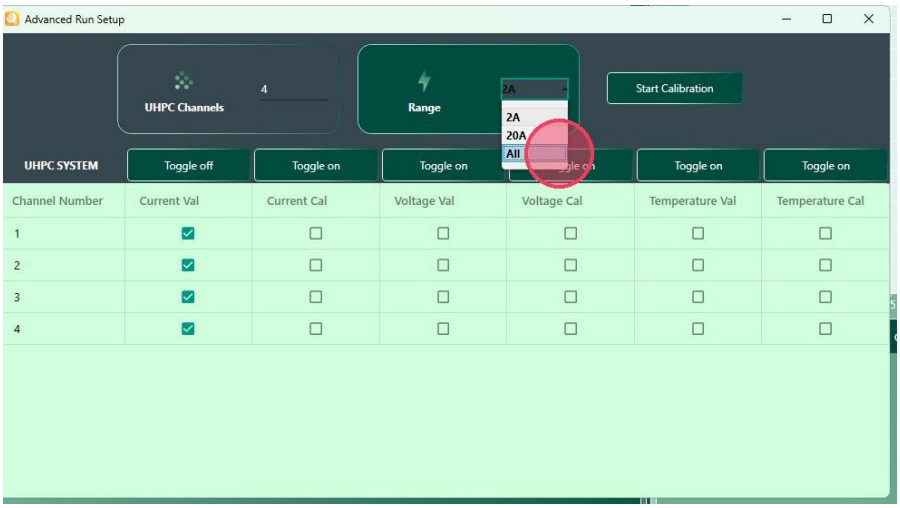


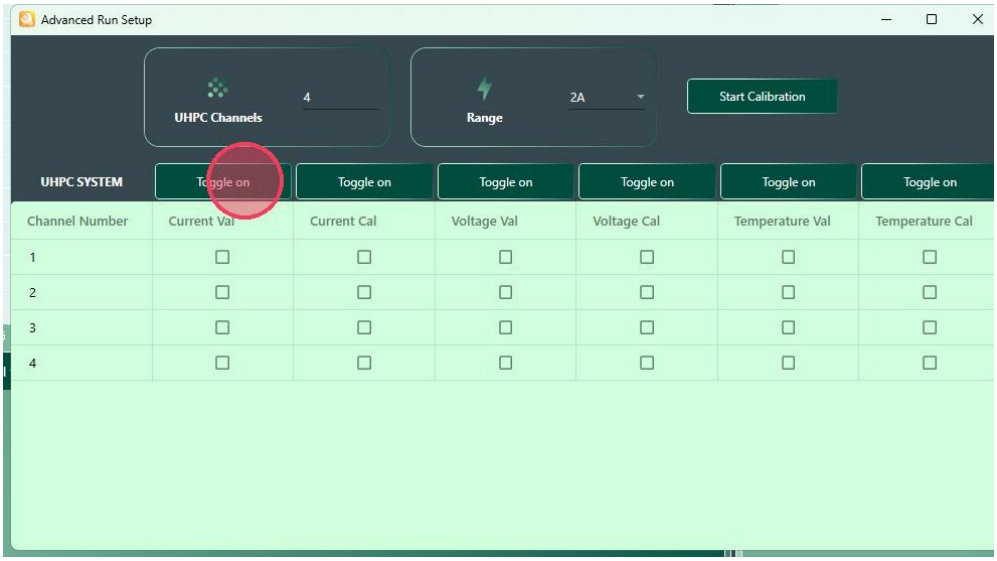
3. Click Debug instead of Proceed. Enter the admin123 Password. Click OK.



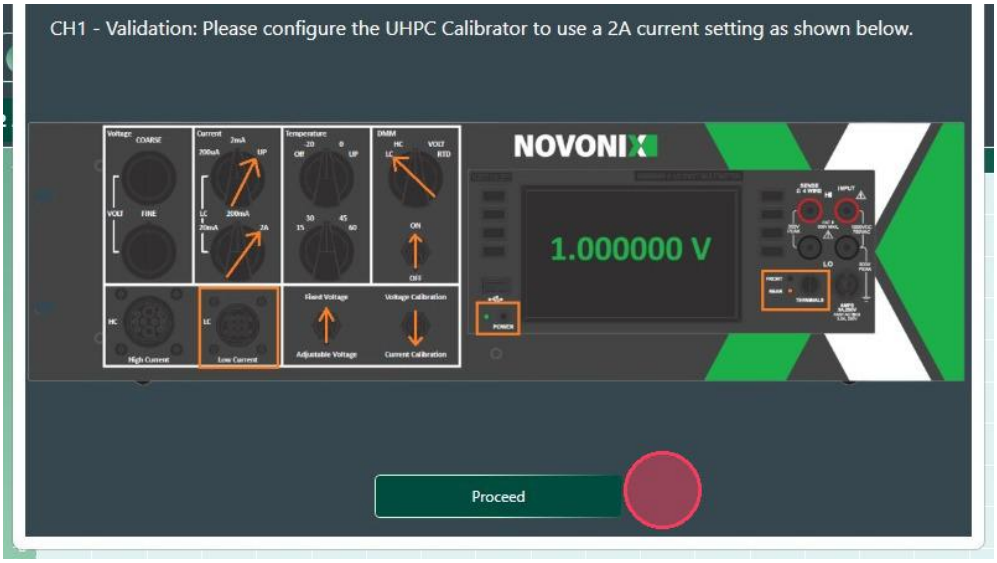


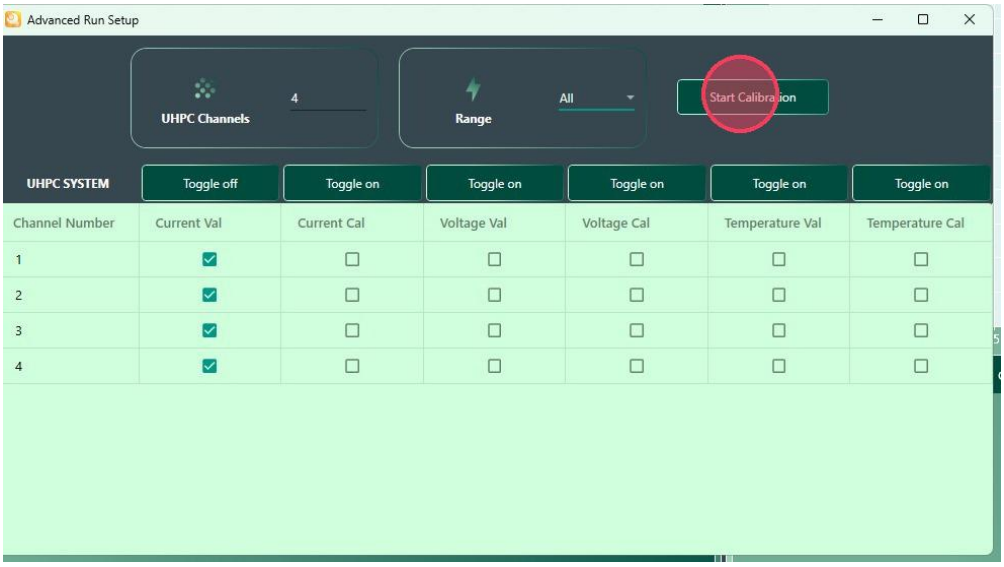
4. In the Advanced Run Setup, you will now see columns for Current Val, Voltage Val, and Temperature Val. Click Toggle On for the fields you would like to validate. Select the ranges you would like to validate. In this example, we are validating a 20 A module, so only the 2 A and 20 A ranges are available.





5. Click Start Calibration to begin the process. Follow the software prompts on your PC to configure your calibrator hardware. This process follows the same workflow used for current, voltage, or temperature validation.





6. The validation will provide error measurements as found on the UHPC channels. The validation workflow typically takes about 50% of the time required for a full calibration, as calibration involves adjusting the appropriate coefficients to generate the line of best fit across the polynomial curve. You will receive a CSV file with this validation data, just as you would with a full calibration.

6.4 Configuring an 8.5 Digit DMM with the UHPC Calibrator

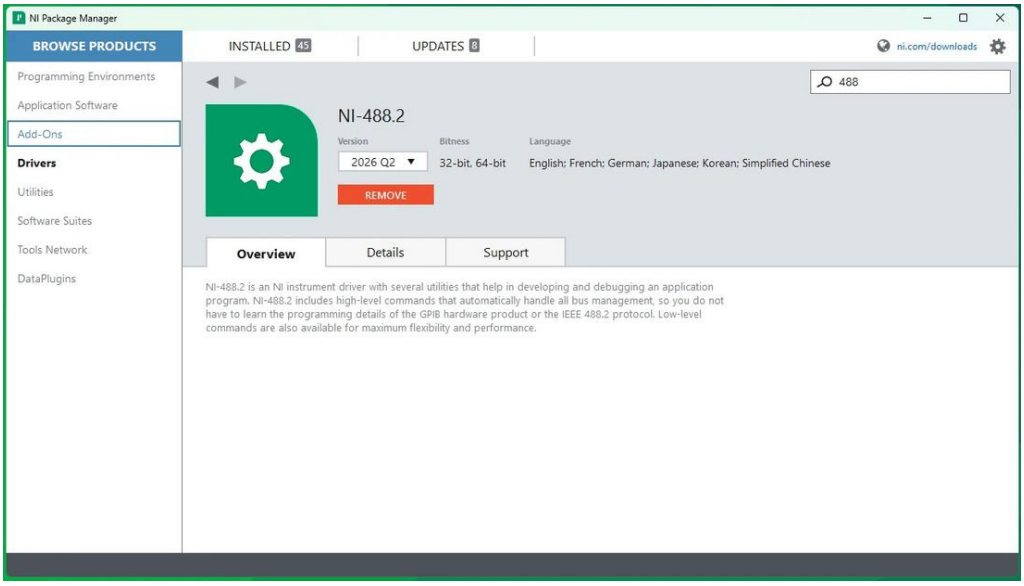
1. Configuring an 8.5 digit DMM with the UHPC Calibrator This guide ensures you correctly set up hardware, drivers, and software so your UHPC calibrator can communicate reliably with an external DMM (e.g., Keysight 3458A). Following it avoids damaging equipment, invalid calibrations, and reduces noise/thermal errors.

2. Required Equipment and Software

   UHPC Calibrator Unit • External Digital Multimeter (e.g., Keysight 3458A or equivalent) • USB-to-GPIB Interface (NI GPIB-USB-HS) • Gold-plated banana cables (recommended for low-noise measurements) • NI Package Manager software • NI-488.2 Driver software (latest version) • UHPC Calibration Software • DMM Configuration File (provided by Novonix)

3. NI Driver Installation

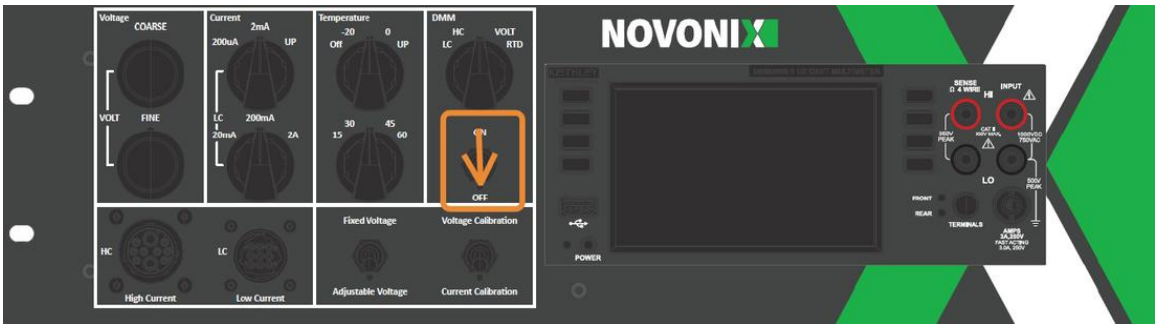
   Launch NI Package Manager on the calibration PC.
   Navigate to the Browse tab and search for “NI-488.2”.
   Select the latest available version of the NI-488.2 driver.
   Proceed with installation by following the on-screen prompts
   Upon completion, restart the PC to ensure the driver is properly initialized and registered with the system.



4. GPIB Interface Verification
   Connect the USB-to-GPIB interface (NI GPIB-USB-HS) to the computer.
   Connect the USB-to-GPIB interface (NI GPIB-USB-HS) to the 3458A Instrument
   Open Device Manager on the PC
   Expand the “NI-GPIB Interfaces” section.
   Verify that “NI GPIB-USB-HS” is listed without warning symbols.
   • If not detected, recheck driver installation and USB connection.

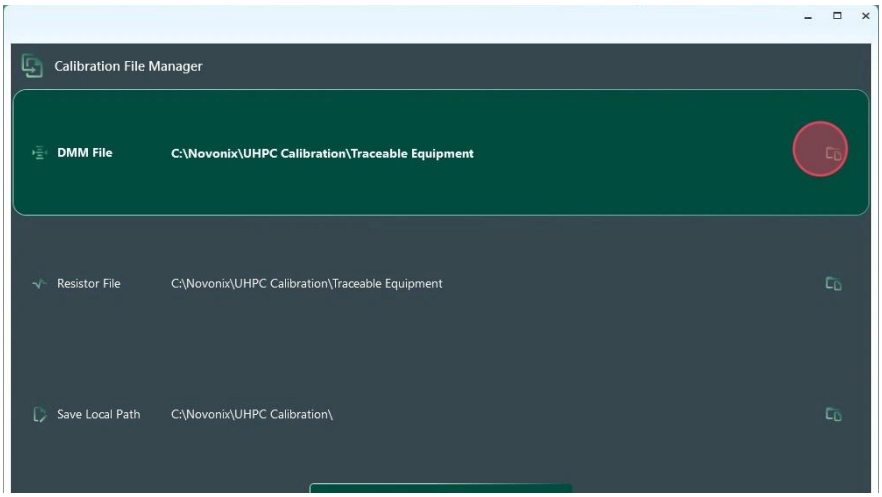
5. Ensure the UHPC calibrator is powered on and in a safe standby state.
   On the front panel of the calibrator, locate the DMM selector switch

Set the DMM switch to OFF to disable the internal meter.

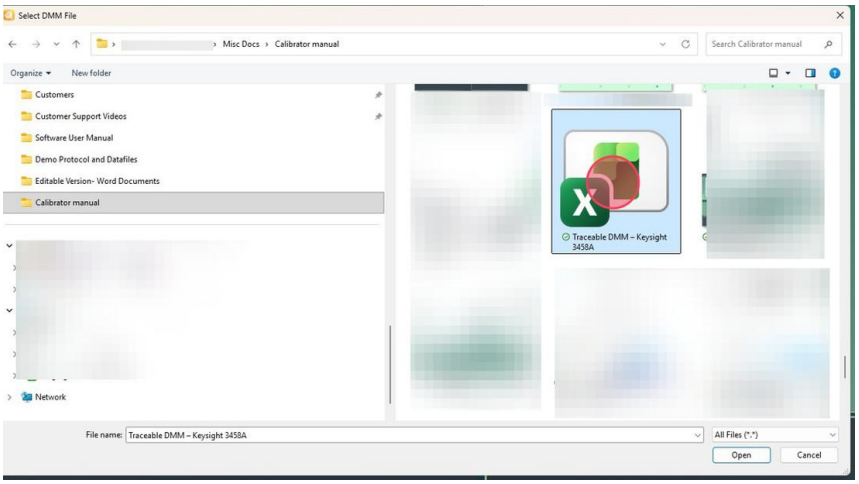


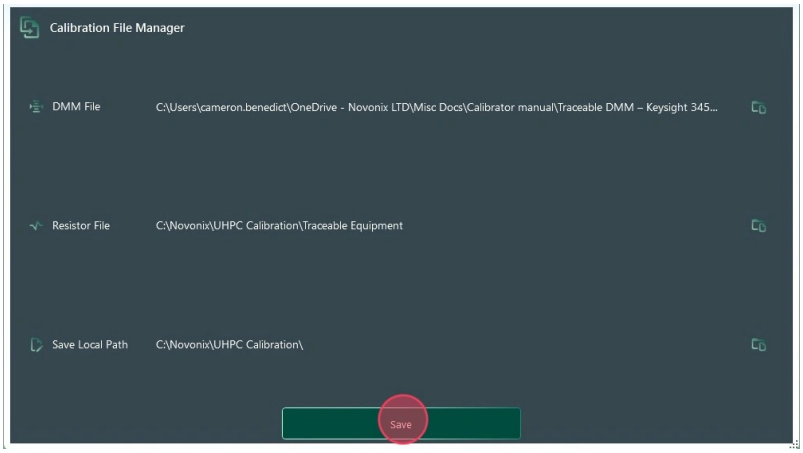
6. External DMM Connection Using gold-plated banana cables, connect the external DMM to the appropriate rear-panel terminals: • INPUT (+/−) for 200 µA to 2 A ranges • SENSE (+/−) for 20 A range
7. Ensure all connections are: • Secure and free from oxidation or contamination • Properly matched in polarity Configure the DMM measurement mode as required (e.g., DC voltage measurement across shunt.
8. Locate the DMM configuration Excel file provided by the Novonix team.
9. Verify that the file includes the exact model number of the external DMM being used.
10. If the required DMM model is not available: • Do not proceed with calibration • Contact technical support for a compatible configuration file

11. Launch the NOVONIX UHPC Calibrate software on the PC Software Configuration
    Launch the UHPC Calibration Software
    Navigate to: File → Calibration File Manager

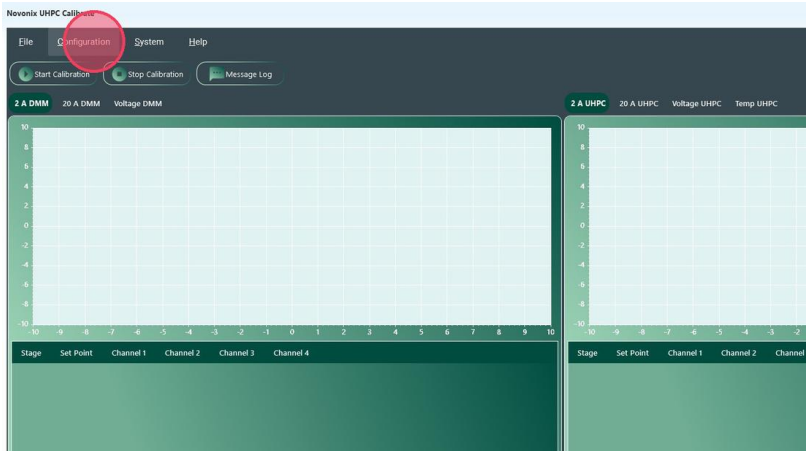


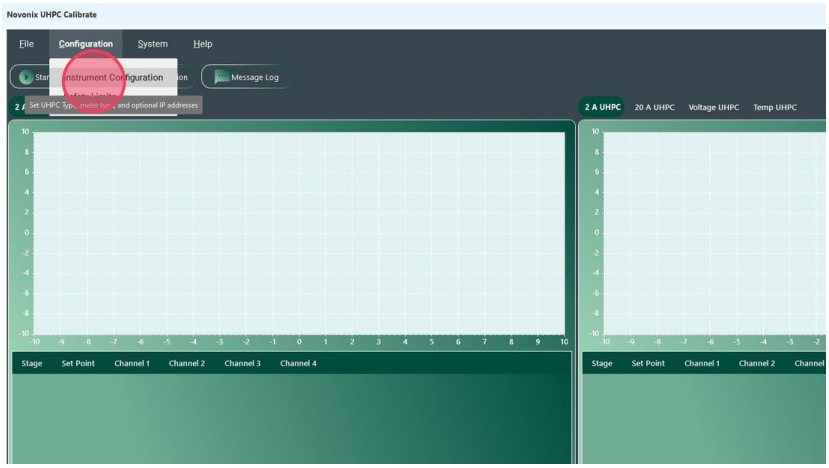
12. 1. Select and load the appropriate DMM file (e.g., Traceable DMM – Keysight 3458A). Save changes



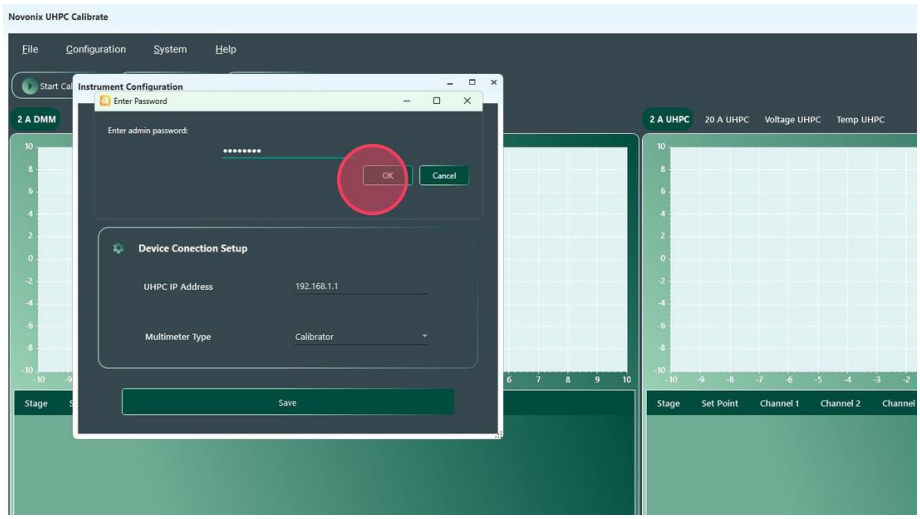


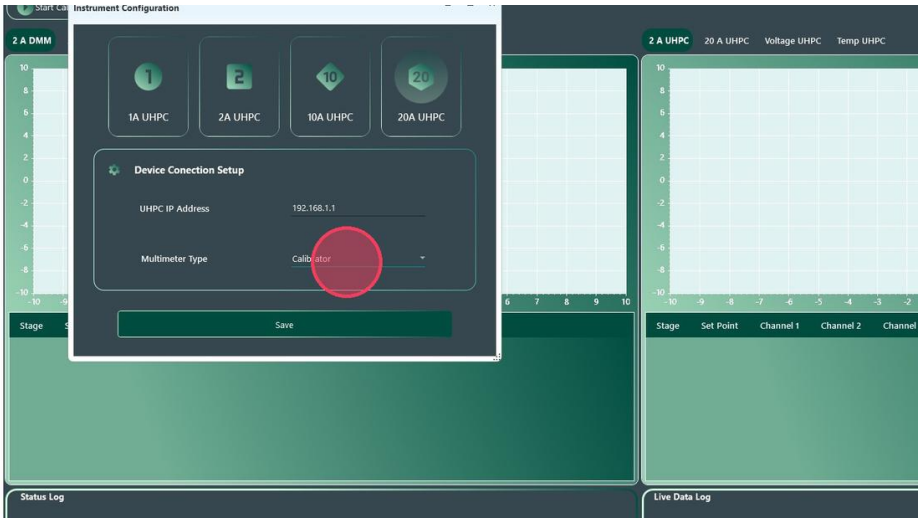
13. Click the “Configuration” button in the main toolbar Select “Instrument Configuration” from the drop-down menu



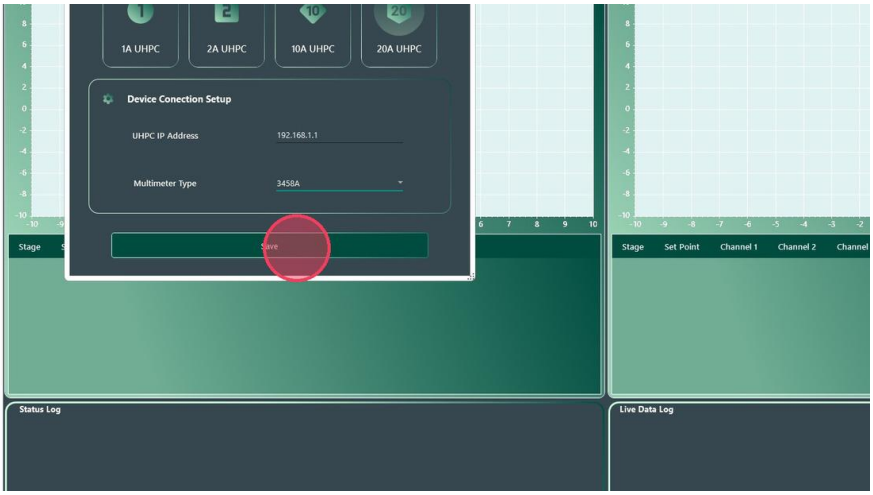


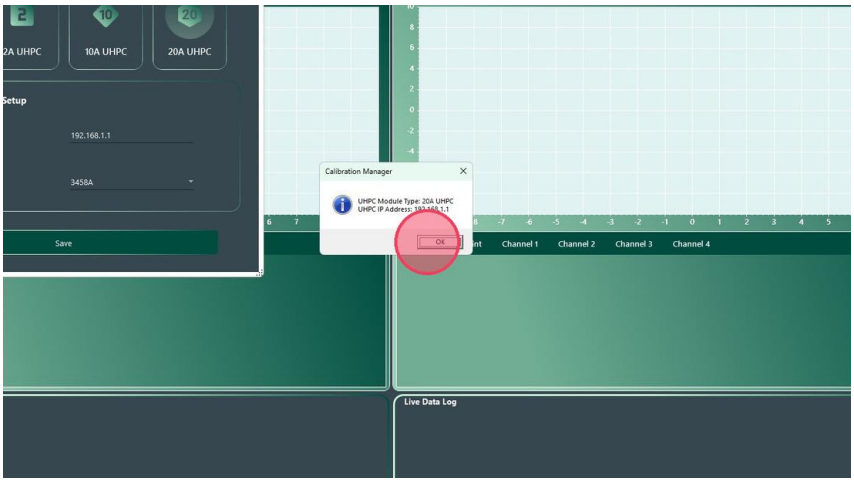
14. From the pop-up window, select “Multimeter Type.” Enter the password: admin123 Click "OK"





15. Click "Instrument Configuration" Click "3458A" Click "Save" Click "OK"





16. Confirm the following before proceeding:

    NI-488.2 driver installed and functioning • GPIB interface detected • External DMM connected and configured • Correct DMM file loaded • Correct UHPC and DMM types selected Notes and Best Practices • Always allow sufficient warm-up time for both UHPC and DMM before calibration. • Use low-thermal EMF connections to minimize measurement error. • Avoid cable movement during measurement to reduce noise. • Ensure environmental conditions (temperature, humidity) are within specification.

7. Contact & Support

Software Downloads and Resource Center: https://avrionlabs.com/customer-area/

Micro Precision Calibration:

Email : eric.knell@microprecision.com
Phone: 1.530.559.9107
Website: microprecision.com