Arbin Instruments

Mits X User Manual

Version Mits X, Rev. 2

Feb 2022

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Introduction

About This Manual

Welcome to the Mits X manual, your introduction and guide to using the most powerful battery test equipment on the market. With step-by-step instructions, this manual will help you to understand the basics of our test equipment hardware, the Mits X software interface, and Arbin Instruments' data tools. With the Mits X software manual as your guide, you can quickly get started with your testing and researching.

This manual provides a comprehensive guide to the core elements of the Arbin battery testing ecosystem. If at any time you have questions about our test equipment or the Mits X software, please contact Arbin Instruments directly using the details below.

Arbin Instruments

Phone: (979) 690-2751

Fax: (979) 690-2761

Email: support@arbin.com

Website: www.arbin.com

In China

Phone for Northeast China, North China, Northwest China,
East China, Central China: 022-86330901/0902

Phone for South China, Southwest,
Hong Kong, and Macau: 020-84219506

General Safety Information

The following safety guidelines help to ensure the safety of yourself and others as well as protect your Arbin battery testing equipment and work environment from potential damage.

WARNING: The end user is responsible for performing the appropriate tests for the specific device under test and to be aware of any characteristic or possible hazards (fire, explosion, burns, electrolyte exposure, etc.) the device under test may pose.

WARNING: Do not operate the Arbin battery test equipment outside of its published voltage and current specifications. If the Arbin equipment is operated outside of its specified voltage and/or current ranges, the protection circuits for the device under test and the Arbin chassis may be impaired. Refer to the SN product record or the label on the chassis for these specifications.

WARNING: For safety reasons, only use Arbin-approved accessories with your Arbin battery test equipment.

WARNING: Do not replace the main chassis power cord with an inadequately rated power cord. To prevent electrical hazard, connect the instrument to an electrical outlet using a three-prong socket for proper grounding.

WARNING: Do not expose the Arbin battery test equipment to moisture, liquid, heat, or corrosive vapor.

WARNING: Do not operate your equipment with any covers removed. This includes computer covers, bezels, filler brackets, front-panel inserts, etc.

WARNING: Fans mounted to the front of the Arbin unit pull air into the chassis. Loose clothing or objects can be pulled into the fan assembly.

CAUTION: For systems weighing more than 18 kg and less than 35 kg, please use a two-person lift.

New in Mits X

The latest version of Arbin's Mits X software offers several new features to enhance your battery testing operations. These added and upgraded features include:

1) Comprehensive user management with 4-level user permissions (Chapter 4)
2) User-friendly wizard to facilitate the creation of new Schedule files (Chapter 6)
3) Schedule Snippet Library for efficient re-use of Schedule components (Chapter 6)
4) Customizable plot templates and the ability to view multiple plots in real-time (Chapter 9 and Chapter 10)
5) Compatibility with Schedule Files from Mits Pro 8.

1: System Requirements and Installation

1.1 Installation Information

1.1.1 System Requirements

Operating System	Interfaces 10 English, 64-bit
System Environment	.NET Framework 4.6.1 or higher
Memory	8 GB and above

1.1.2 Connection Details

1) Set the TCP/IP Address:
   a) The local console connects to WinDaq using 127.0.0.1.
   b) The remote console connects to WinDaq using the LAN IP address.
   c) The network card address of WinDaq connected to the Arbin cycler is configured as 196.168.1.100.

1.2 Install Mits X

There are currently two options for installation Mits X, package installation and free installation. The following instructions cover the steps for both installation options.

1.2.1 Package Installation

1) Unzip the Mits X installation package.
2) The Mits X installation package has four primary components:
3) Setup.exe - The installation program.
4) Arbin_MySql_Auto – Required files for the MySql software.
5) SQLEXPRADV_x64_ENU – Required files for the SQL Server software installation, including automatic installation scrips and custom installation software.
6) README.text

7) Run the Mits X Installation Wizard.

   a) Double-click on Setup.exe to enter the Mits X Installation Wizard.

Figure 1-1 Mits X Installation Wizard

   b) Click "Next" on the bottom right of the Installation Wizard.

Figure 1-2 Starting the Mits X Installation

   c) Read the license terms, select "I accept the terms of the license agreement," and click "Next" to proceed with the installation.

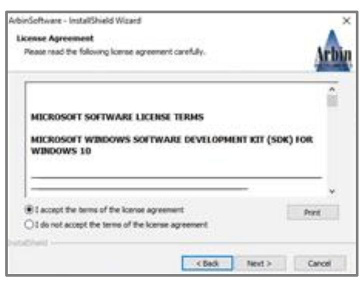


Figure 1-3 Mits X Installation License Agreement

d) Complete the Environment Check.
   i) This step confirms that the computer meets the requirements for installing the Mits X software. These requirements are:
      (1) Interfaces 10, 64-bit operating system
      (2) English language system
      (3) .NET Framework of 4.6.1 or higher
      (4) RAM memory of 8 GB or above
   ii) If any of the conditions are not met, the installation cannot be completed.
e) Once the Environment Check is complete, click "Next" at the bottom right of the Interface to go to the next step.

Figure 1-4 Mits X Environment Check

f) Choose the installation mode, Complete or Custom.
   i) Complete installation installs Console, WinDaq, and SQL Server, and will save the installation content in the default path.
      (1) Select the "Complete" installation option.

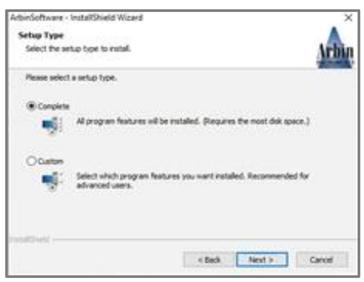


Figure 1-5 Select the Complete Installation Option

      (2) Review the installation details, then click the "Install" button on the lower right of the Installation wizard to start the installation.

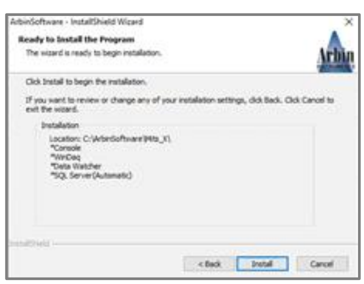


Figure 1-6 Complete Installation Details

8) Custom installation allows you to modify both the installation content and the installation path.

   (1) Select the “Custom” installation option, then click “Next” to proceed to the next step.

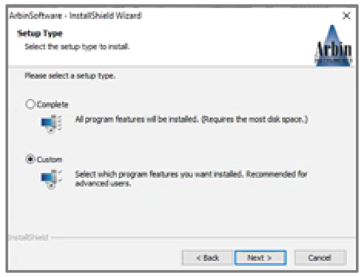


Figure 1-7 Select the Custom Installation Option

   (2) Select the destination path for the installation and click “Next.”

Figure 1-8 Select the Destination Path for Mits X Installation

   (3) Select the content that you want to install, then click “Next.”

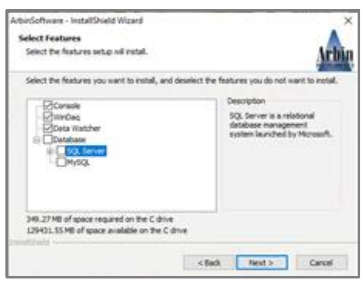


Figure 1-9 Select the Content for Mits X Installation

   (4) Review the installation details, then click the “Install” button on the lower right of the Installation Wizard to start the installation.

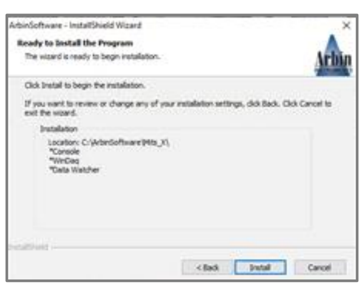


Figure 1-10 Custom Installation Details

b) Complete the installation.
    i) Wait for the installation process to finish.

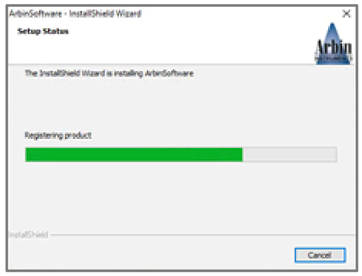


Figure 1-11 Mits X Installation in Progress

    ii) Click the "Finish" button to exit the Mits X Installation Wizard.

Figure 1-12 Completed Mits X Installation

1.2.2 Free Installation

1) Make sure that computer meets the Mits X software requirements:
2) Interfaces 10, 64-bit operating system
3) English language system
4) .NET Framework of 4.6.1 or higher
5) RAM memory of 8 GB or above
6) Copy the Mits X directory from the installation U disk to the computer.
7) You can now use the Mits X directory directly.

1.3 Uninstall Mits X

Choose Your Uninstall Method:

1) Uninstall using Uninstall ArbinSoftware.
    a) Double-click on the "Uninstall ArbinSoftware" icon to open the Uninstall Wizard.

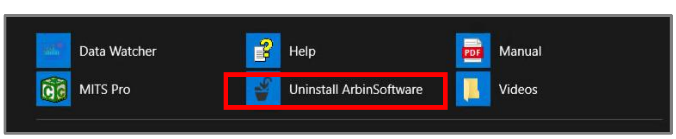


Figure 1-12 Uninstall ArbinSoftware Icon

b) Click “Yes” on the Wizard to confirm the uninstall of Mits X.

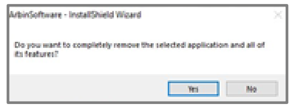


Figure 1-13 Confirm Uninstall of Mits X

2) Uninstall using Setup.exe.
   a) Double-click “Setup.exe” to open the option interface.
   b) Select “Remove” from the options that appear in the Wizard, then click “Next” to proceed with the uninstall.

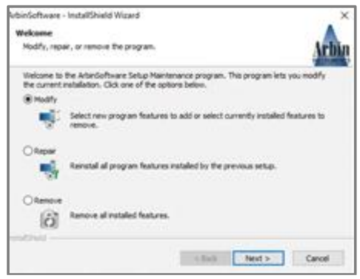


Figure 1-14 Select the Remove Option to Uninstall Mits X

   c) Click “Yes” on the Wizard to confirm the uninstall of Mits X.

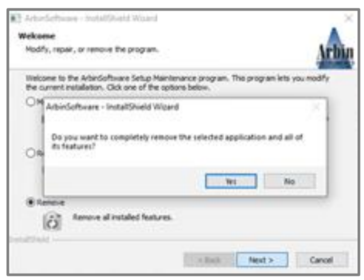


Figure 1-15 Confirm the Uninstall of Mits X

   d) After the uninstall process is complete, click the “Finish” button to exit the Wizard.

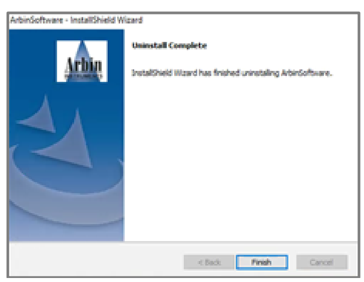


Figure 1-16 Completed Uninstall of Mits X

2: Initial Setup

Thank you for choosing Arbin Instruments for your battery test equipment. Arbin offers the most advanced circuits and software functions on the market, to provide you with excellent test performance and extensive flexibility for editing test programs. Arbin Instruments designs test platforms for every specific application; please refer to **Appendix A: Control Type Function Descriptions** to review the available control types and voltage/current specifications.

2.1 Set Up the Equipment

Each Arbin battery tester has been thoroughly tested, calibrated, and fully loaded with burn-in operations in the factory. However, equipment sometimes encounters rough handling during transportation. Please take a few minutes to complete the inspection procedures below to ensure that your Arbin battery test equipment is undamaged and ready to run your tests.

2.1.1 Inspect the Equipment

1) Make sure that the Arbin equipment is not plugged in while you perform the inspection.
2) Complete the following inspections before starting your Arbin battery test equipment.
3) Check all packages for external damage before opening. If the warning on the package shows obvious damage or signs of damage, it should be reported to the shipping company immediately.
4) Confirm that the thumbscrews of all boards and modules are firmly tightened to the front of the chassis.
5) Remove the panel covering the microcontroller board (the blank panel attached with Philips screws, inserted between 3-5 channel board groups).
6) Press the board firmly to ensure firm contact with the back BUS board.
7) Ensure that the Ethernet connector (if included with your Arbin tester) is firmly attached on the front panel of the test bench.
8) Check for any obvious signs of transportation damage to the main components of the test bench cabinet.
9) There should be no visible damage to the outside of the test bench or the computer equipment.
10) There should be no visibly or audibly loose parts inside the test bench chassis or PC.
11) The circuit board should be in a vertical or horizontal orientation.
12) An inclined orientation of the circuit board indicates that the system has been severely dropped or treated roughly during transportation, resulting in damage to the circuit board mounting components or tracks.
13) The connection between each circuit board and the backplane should ensure that the electrical and communication signals have solid contact.

2.1.2 Assemble the System

1) Connect the main components of the system.
2) Connect the Arbin case and computer to an appropriate power source.
3) Please note that cabinets and computers may have different power supply voltage ratings (220V or 208V and 110V).
4) Connect the computer's Ethernet cable (TCP/IP) to the front of the Arbin test equipment chassis.
5) If a different connection scheme is required, it will be provided.
6) Connect other computer components, including monitors, keyboard, mouse, speakers, and UPS (if included).

NOTE: Under no circumstances should users install any third-party UPS management software. Mits X includes its own power failure trigger; the presence of any other utility program will impair the system's ability to detect failures and respond appropriately when shutting down or recovering from a test. For more information, please refer to **19.2 UPS**.

7) Connect the computer's Ethernet cable (TCP/IP) to the front of the Arbin tester.

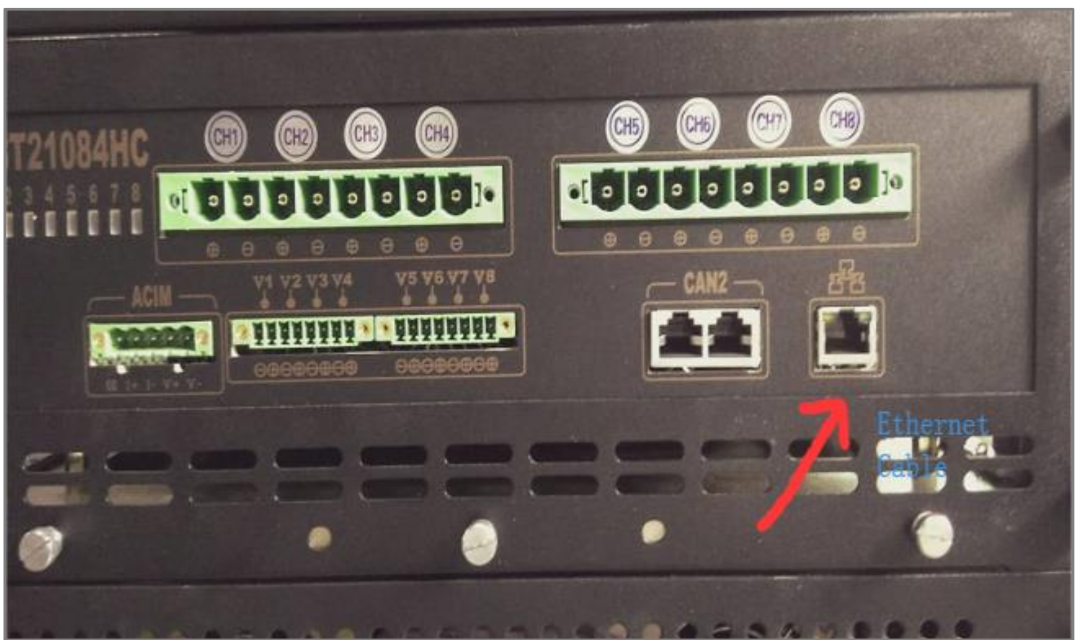


Figure 2-1 Ethernet Port on an Arbin Tester

8) Connect the battery cables. For a detailed explanation of battery cable connection methods, please refer to **18.1 Hardware Structure**.
9) Review the system specifications.

NOTE: It is very important to understand the specifications for the main channel current/voltage, auxiliary channel, additional functions, and test bench power. The above rated specifications are listed on the label on either the front or the back of your Arbin battery test equipment. The image below shows a blank version of the specification sheet.

<table>
<tr><td colspan="6">CUSTOMER ORDER SPECIFICATION SHEET</td></tr>
<tr><td colspan="6">The following are the specifications of the Arbin unit. Please plan accordingly to prepare for the arrival of the unit.</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td>CUSTOMER:</td><td colspan="4"></td><td rowspan="4">Circuitry:
☐BIPOLAR
☐PWM</td></tr>
<tr><td>System Serial No. :</td><td colspan="4"></td></tr>
<tr><td>Model:</td><td colspan="4"></td></tr>
<tr><td>Est. Delivery Date:</td><td colspan="4"></td></tr>
</table>

Current & Voltage Channel Specifications					
CH No.	IH Range	IM Range	IL Range	V Range H/L	Max. Power

Auxiliary Channel & Additional Function Specifications						
CH No.	Second Voltage	Temperature	Pressure	High Speed Pulse	ACIM	Others

Chassis Dimensions:	W x L x H: (Inch)	

Power Requirements:

Single-Phase: (V)		Max. Power: (VA)		Frequency: (Hz)
Three-Phase: (V)		Max. Power: (VA)		

Power Socket Requirements:	Refer to specification Sheet attached.

Notes:

	For 3-phase Y-connected power supply, please ensure the following Voltages:

	V_{Phase} - V_{Ground} = 110V (for all three phases)
	*V_{phase} - V_{phase} = 208 V (for all three phases)
	*The unit can also be configured to run at 208V three-phase if your facility requires that configuration. Please let us know immediately if that is your requirement.

2.2 Set Up the Mits X Software

WARNING: Interfaces 10 and Mits X have been pre-installed on the computer. Please do not reinstall any Microsoft or Arbin software without the permission of Arbin Customer Support.

2.2.1 Open the Mits X Program.

1) Start up the computer and Arbin battery test equipment.
   a) Power on the Arbin battery test equipment and the computer.
2) Log into the computer.
   a) Enter the username “Arbin” and password “arbin” to access the Interfaces desktop.
   b) If this username and password does not work, contact Arbin Customer Support for the appropriate password.
3) Double-click the “WinDaq.exe” icon to display the WinDaq page of Mits X. The user program appears as an interface application.

Figure 2-2 The WinDaq.exe Icon

4) Double-click the “Console.exe” icon to display the Mits X login interface.

Figure 2-3 The Console.exe Icon

NOTE: For information on user permissions levels, refer to **Chapter 4: User Accounts and Permissions**.

2.2.2 Log into the Mits X Software

Open the Login Interface

1) Click on “Login” on the Mits X menu.
2) Click on the “Login” icon to open the Login Interface.

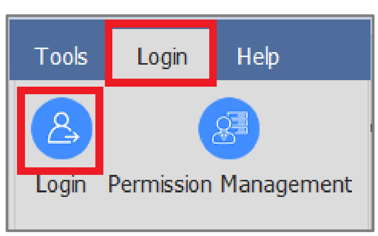


Figure 2-4 Login Button and Login Icon

Complete the Login Interface Fields

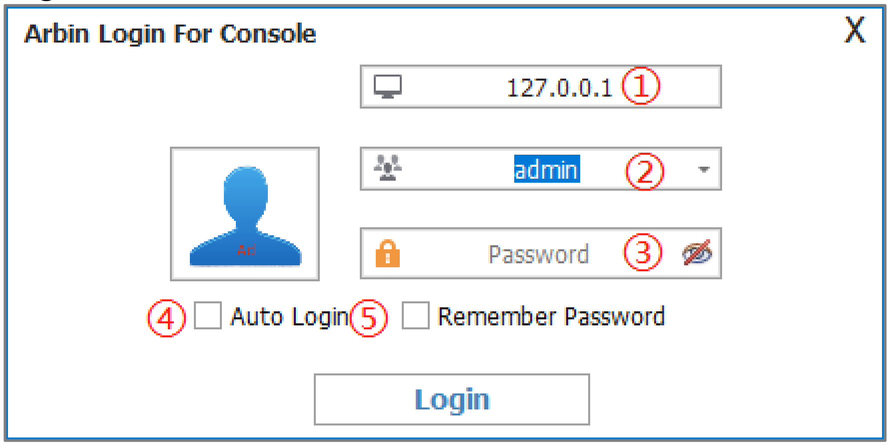


Figure 2-5 Mits X Login Interface

1) Fill in the IPv4 address of the computer you are using to run Mits X.
2) Fill in the username.
3) Fill in the password.
4) Select whether to automatically login with the entered information.
5) Select whether Mits X should store your password for the next time you login.

2.2.3 Register Your Mits X Software

Registration is required to perform normal test functions within Mits X once the trial period has expired.

1) Click on "Help" on the Mits X menu.
2) Click on the "Registered" icon to open the Registration Interface.

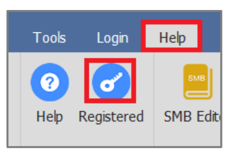


Figure 2-6 Registered Icon

3) Choose your registration method: Use Registration File or Use Registration Key.

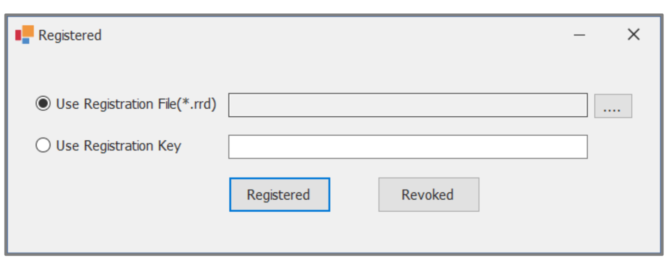


Figure 2-7 Registration Interface

4) Fill in the corresponding information for your selected registration method.
5) Click the "Registered" button to register the Mits X software or click the "Revoked" button to cancel the software registration.

2.3 Test the Equipment

2.3.1 Set Up the Diagnostic Test

Arbin Instruments recommends each new installation start with a diagnostic test. This test should be completed to verify the performance of the new system before analyzing any propriety or non-standard samples.

The diagnostic test requires a resistor with bipolar current and power ratings to diagnose the instrument, or a battery to diagnose the system and check specific indicators. Each type of resistance or battery test object can be located in the special diagnostic test program, which is stored in the “qc” directory of the hard disk where the Mits X program files are located (C:\Arbinsoftware\qc-xxxx, where “xxxx” is typically the serial number).

1) Connect the resistor or resistors.
    a) If a resistor with an appropriate load value is available, connect it to a physical channel on the battery tester chassis.
    b) If several such resistors are available, connect them to different chassis, models, and units as needed.

The power range of Arbin’s custom-designed test equipment ranges from under one watt up to hundreds of kilowatts. Arbin uses a diverse range of circuits to design these systems, then thoroughly tests them at the factory. The details and results of these testing programs are stored on the Arbin-provided PC and the USB flash drive included with this manual. We have also included a separate document that describes the equipment used to perform specific tests on your Arbin battery test equipment.

You can run your own performance tests by copying our test conditions. You will then be able to compare the results data with the data generated by Arbin to ensure accurate functionality.

Along with testing details and results, the USB flash drive includes a backup of the Mits X software. The flash drive should have the serial number of your particular battery test equipment on it, written on a white label. If you cannot locate the testing program details in either of these two places, please contact Arbin Customer Support.

NOTE: For details on creating and editing Schedules, refer to **Chapter 6: Schedule Files**.

1) Set up the program for the diagnostic test.
2) Locate the file “ab-funsc.sdx” in the “C:\Arbinsoftware\qc-xxxx” folder.
3) Copy the file to the “C:\Arbinsoftware\Mits X\WinDaq\Work” folder.
4) Connect the testing device to the system.
5) To use a suitable device for this test, open the test Schedule and click the “Global” tab.
6) The section labeled “Information/Comments” describes the devices used to test your equipment at Arbin.
7) Connect the testing device to each channel of the system to ensure that each board is working properly.

2.3.2 Run the Diagnostic Test

1) Start the diagnostic test.
   a) Select the schedule name in the Mits X console.
   b) Right-click to assign "ab-funsc.sdx+TestObject.to" to the channel connected to the test object. (For more information, refer to the distribution test procedure in **6.2 Manage Schedule Files**.)
   c) On the monitoring and control Interface, select the channel that has been loaded with resistance or a battery.
   d) Click the "Start" button. (For more information, refer to **10.2 Manage Tests with the Monitor Toolbar**.)
2) Run the diagnostic test.
   a) In the startup dialog box, enter the "funsc" as the result file name.

NOTE: In the rest of the first step of ab-funsc.sdx, the voltage reading on the monitoring and control Interface should be close to the rated voltage of the relevant test battery, or a very small voltage value on the resistor. Otherwise, there is a communication problem between the chassis and the computer. In this case, please contact Arbin Customer Support.

3) If "UNSAFE is not safe" appears after the second step of "Current Ramp," please check the battery voltage and the connection with the chassis.
4) The test result data should be similar to Figure 2-8 below, although different systems will have different values. If the data differs from this graph, please save a copy of the graph and contact Arbin Customer Support.

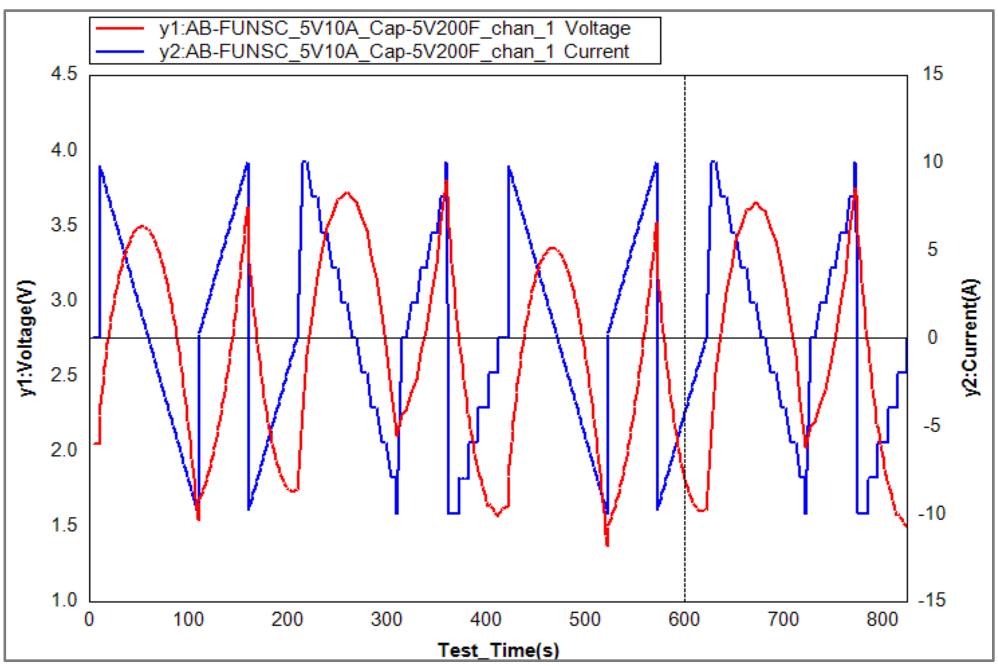


Figure 2-8 Function Test Current and Voltage Diagram, AB-FUNSC

The following is a detailed description of the test program template. The pre-defined program "ab-funsc.sdx" is used to check all standard functions of the Arbin battery testing system, including every available mode of the hardware and software interface. The channel's ability to execute this program is a valuable indicator of the system's normal operation.

NOTE: The maximum current described below is the maximum current of range 1, and the minimum current is the negative value of the maximum current.

1) Rest for 10 seconds.
2) Run a current ramp using Range 1 from the maximum current to the minimum current.
3) Charge using a current ramp from 0 A to the maximum current using Range 1.
4) Discharge using a current ramp from the minimum current to 0 A using Range 1.
5) Run a current staircase from the maximum current to minimum current using Range 1.
6) Run a current staircase from 0 A to the maximum current.
7) Run an internal resistance check on Range 4.
8) Run an internal resistance check on Range 3.
9) Run an internal resistance check on Range 2.
10) Run an internal resistance check on Range 1.
11) Discharge using a current staircase from the minimum current to 0 A.
12) Increment the cycle index and repeat once from the first step.

2.3.3 Turn Off the System

1) Close the Mits X applications, including Console.exe and WinDaq.exe.
2) Shut down the Interfaces operating system.
3) Turn off the power on the computer and the Arbin battery test equipment.

3: Overview of Mits X

3.1 Introduction to the Mits X Software

3.1.1 Mits X Software Composition

The Mits X software has two main components, the server application WinDaq, and the client application Console. The main directories of these two applications contain the important file "ArbinSys.cfg." This file is related to the hardware system configuration and calibration data, which are the basis for test system accuracy.

3.1.2 Mits X File Organization

All test programs and batch files are contained in the C:\Arbinsoftware\Console(WinDaq) directory. The following table includes descriptions and locations for Mits X files.

Directory Name	Location	File Name
Console	C:\ArbinSoftware\Console	Console.exe, ArbinSys.cfg, ArbinAdvSys.cfg, ArbinSduModel.xml, ArbinSys.DBCF
WinDaq	C:\ArbinSoftware\WinDaq	WinDaq.exe, ArbinSys.cfg, ArbinAdvSys.cfg, ArbinSduModel.xml, ArbinSys.DBCF
Work Directory	C:\ArbinSoftware\Console(WinDaq)\Work(\...)	All mapping files (*.bth) all schedule files (*.sdx)
Profiles_TestObject	C:\ArbinSoftware\Console(WinDaq)\ Profiles_TestObject	all test object files (*.to)
Profiles_ReportChart	C:\ArbinSoftware\Console(WinDaq)\ Profiles_ReportChart	all chart files(*.cht)
Profiles_CANBMS	C:\ArbinSoftware\Console(WinDaq)\ Profiles_CANBMS	all CAN BMS configure files(*.can)
Profiles_SMB	C:\ArbinSoftware\Console(WinDaq)\ Profiles_SMB	all SMB configure files(*.smb)
Profiles_Simualtion	C:\ArbinSoftware\Console(WinDaq)\ Profiles_Simulation	simulation files(*.txt)

DataWatcher Directory	C:\ArbinSoftware\DataWatcher	DataWatcher.exe
Logs Directory	C:\ArbinSoftware\Console(WinDaq)\ Console(WinDaq)Logs C:\ArbinSoftware\Console(WinDaq)\ ReportProblem	All Auto Calibration files, online edited schedule files, Data Log Information file, My Arbin Information files, Report Problems, Schedule online edit Record files, System Version information files, and Temp ChamberData

The system configuration file includes the following:

1) Arbinsys.cfg
2) ArbinAdvSys.cfg
3) ArbinSys.DBCF (SQL database setting)
4) Account Permissions

3.2 Introduction to the Mits X User Interface

3.2.1 The WinDaq Server Software and User Interface

The WinDaq server is mainly an intermediary between the cycler and the Console client. It displays the connection status between WinDaq and the Console client in real time, as well as the connection status between WinDaq and the cycler hardware.

As shown in Figure 3-1, it consists of a toolbar and a status Interface.

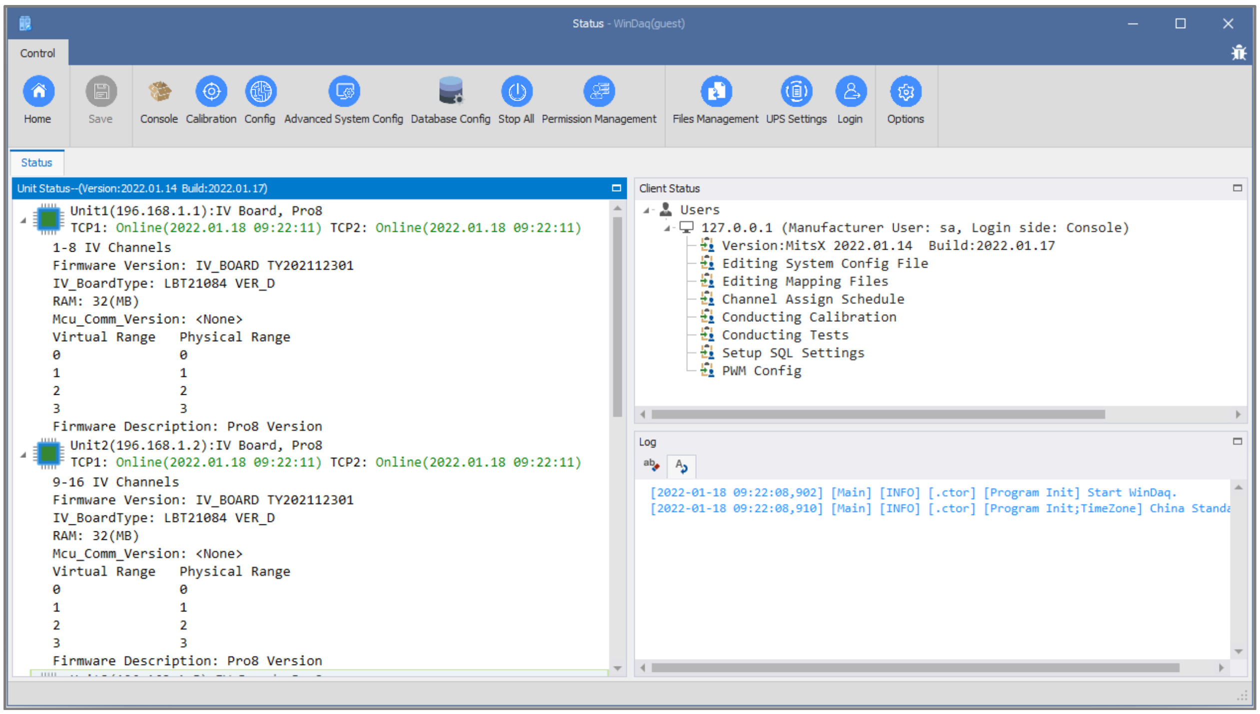


Figure 0-1 WinDaq Interface

The WinDaq Server Software Toolbar

1) Home: Return to the Home page.
2) Save: Save the file content, only available from the File editing page.
3) Console (Client Application): Open the client application.
4) Calibration: Open the Hardware Calibration Interface.
5) Config (Configuration Information): Configure software and hardware device connection information.
6) Advance System Config: Open the Advanced System Config Interface.
7) Database Config: Open the Database Configuration Interface.
8) Stop All: Stop all channels that are currently running tests.
9) Permission Management: Open the Permission Management Settings Interface.
10) File Management: Backup and restore the Settings Files.
11) UPS Setting: Open the UPS Power Configuration interface.
12) Login: Open the User Login Interface.

The Status Interface

1) Unit Status: Display the status information of the connected device.

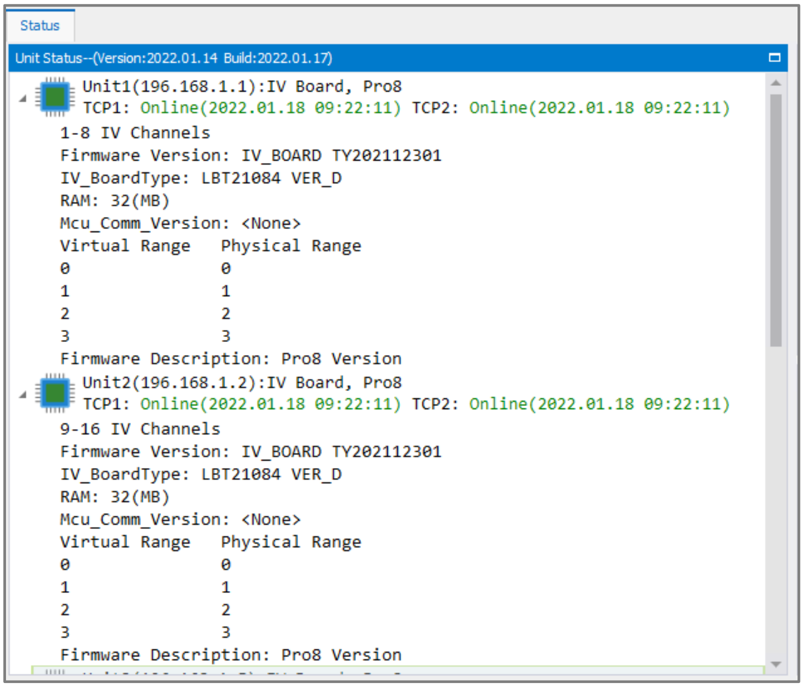


Figure 3-2 Unit Status Interface

2) Client Status: Display the status information of the connection client.

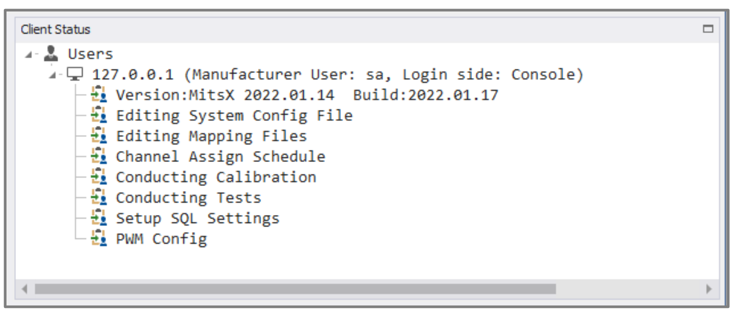


Figure 0-2 Client Status Interface

3) Log: Record the information of the software in use.

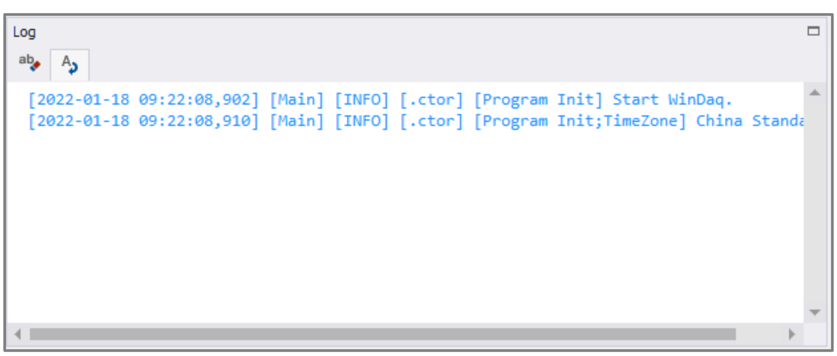


Figure 0-4 Log Interface

3.2.2 The Console Client User Interface

The Console Client user Interface provides options for editing files including test programs, target files, report chart files, BMS files, and system configuration files. It also includes options to start and control tests, calibrate hardware, start DataWatcher, and many additional software tools for battery testing.

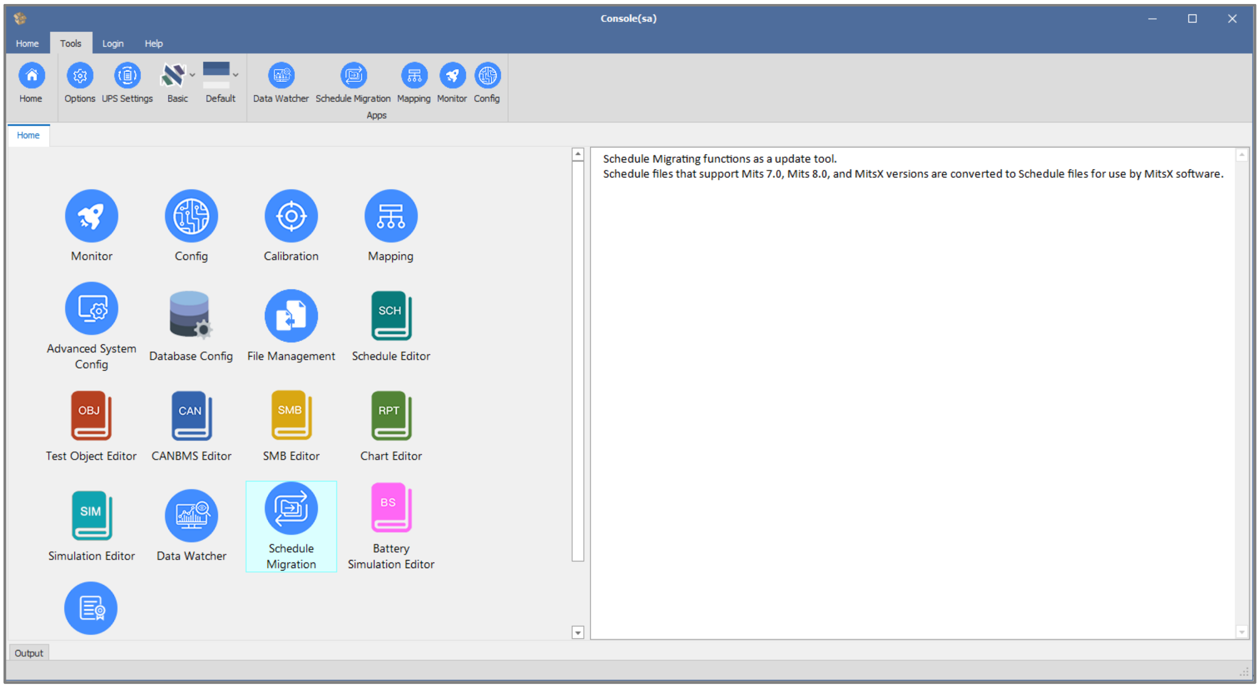


Figure 3-5 The Console Client User Interface

The Menu Toolbar

The Menu Toolbar at the top of the Console Client user interface contains five options: Home, Tools, Login, and Help. The following are the actions for each menu option.

1) The Home Menu
   a) **Home:** Return to the Home page.
   b) **Monitor:** Open the Monitor Interface.
   c) **Mapping:** Open the Mapping Interface.
   d) **Schedule Editor:** Open the Schedule Editor.
2) The Tools Menu
   a) **Home:** Return to the Home page.
   b) **Options:** Manage the display of the Console Client interface.
   c) **UPS Settings:** Open the UPS Power Configuration interface.
   d) **Basic:** Change the style of the interface.
   e) **Default:** Change the color palette of the interface.

3) The Login Menu
4) **Home:** Return to the Home page.
5) **Login:** Open the User Login Interface.
6) **Permission Management:** Open the Permission Management Settings interface.
7) The Help Menu
8) **Home:** Return to the Home page.
9) **Help:** Opens the digital version of this User Manual.
10) **Registration:** Open the Registration Interface for the Mits X software.
11) **Arbin Testing Info:** Shows the test equipment description and specifications.

3.2.3 Mits X User Interface Gallery

The **Monitor interface** is used for monitoring and controlling channels.

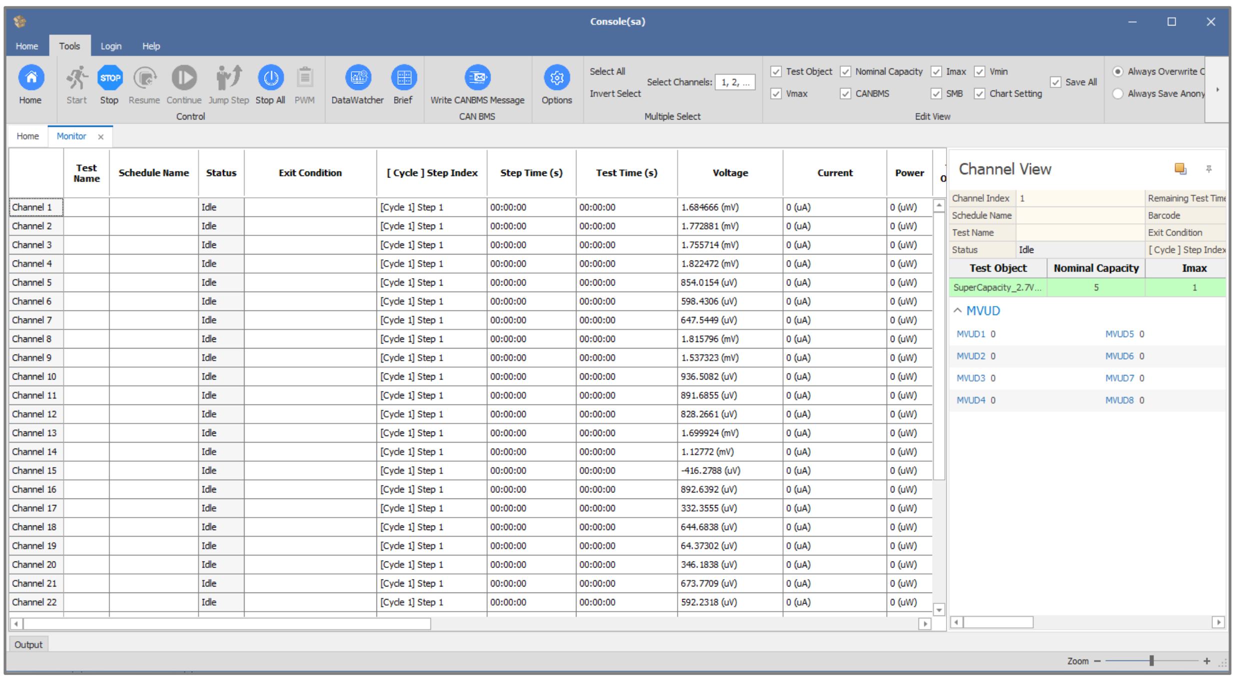


Figure 3-6 The Monitor Interface

The **Config (Configuration) Interface** is used to configure the software and hardware device connection information.

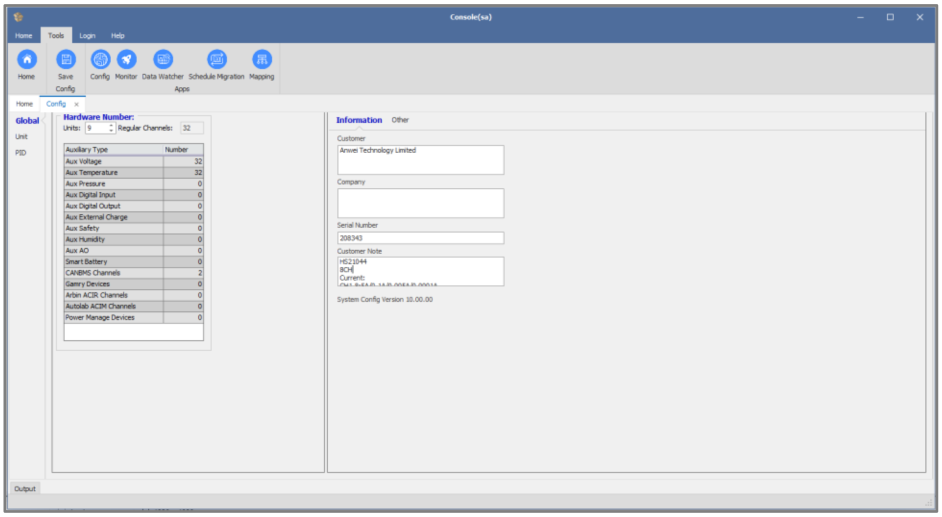


Figure 3-7 The Config (Configuration) Interface

The **Calibration Interface** is used for channel calibration.

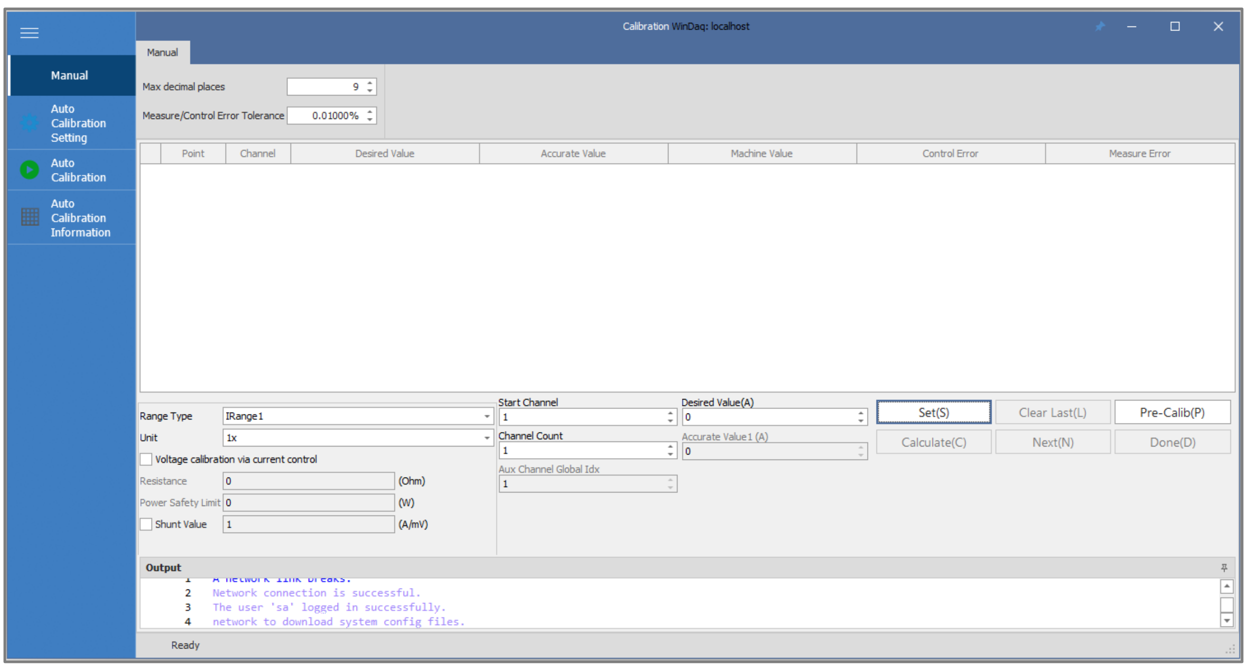


Figure 3-8 The Calibration Interface

The **Mapping Interface** is used to configure the auxiliary information required by the channel. The Mapping file (file extension .bth) provides a mapping page to detail the connection between the main IV channel and the auxiliary channel.

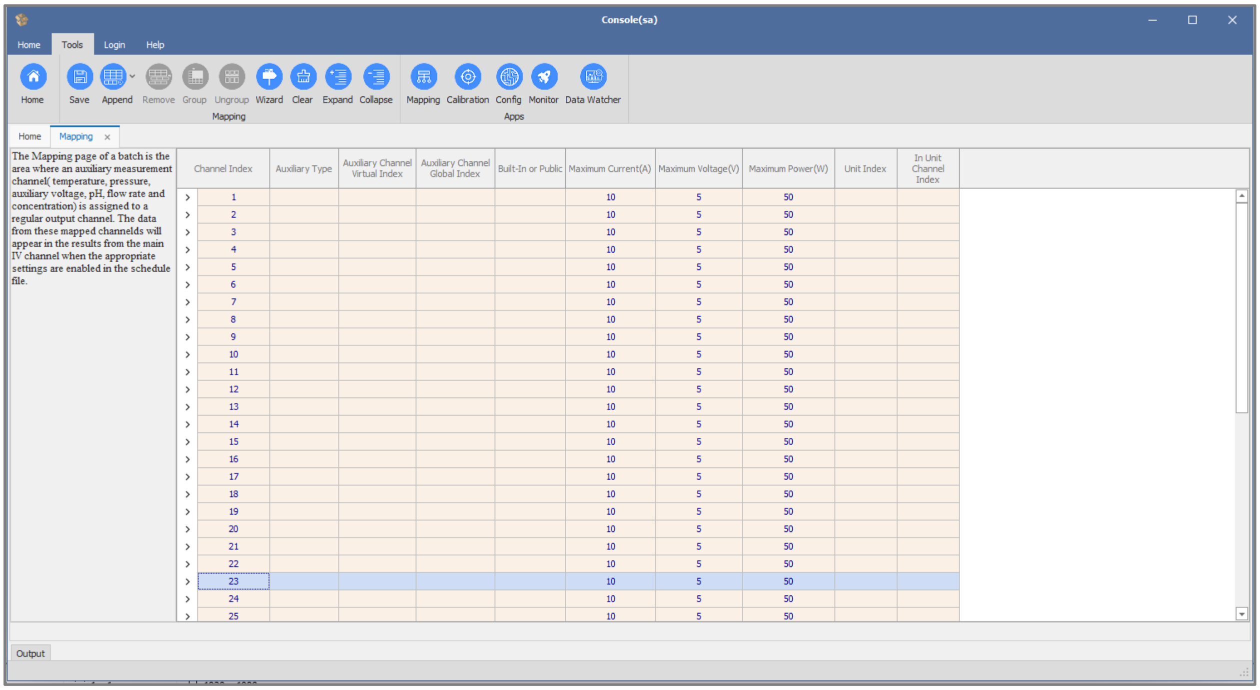


Figure 3-9 The Mapping Interface

The **Advanced System Config (Configuration)** Interface is used for setting required functions by device series.

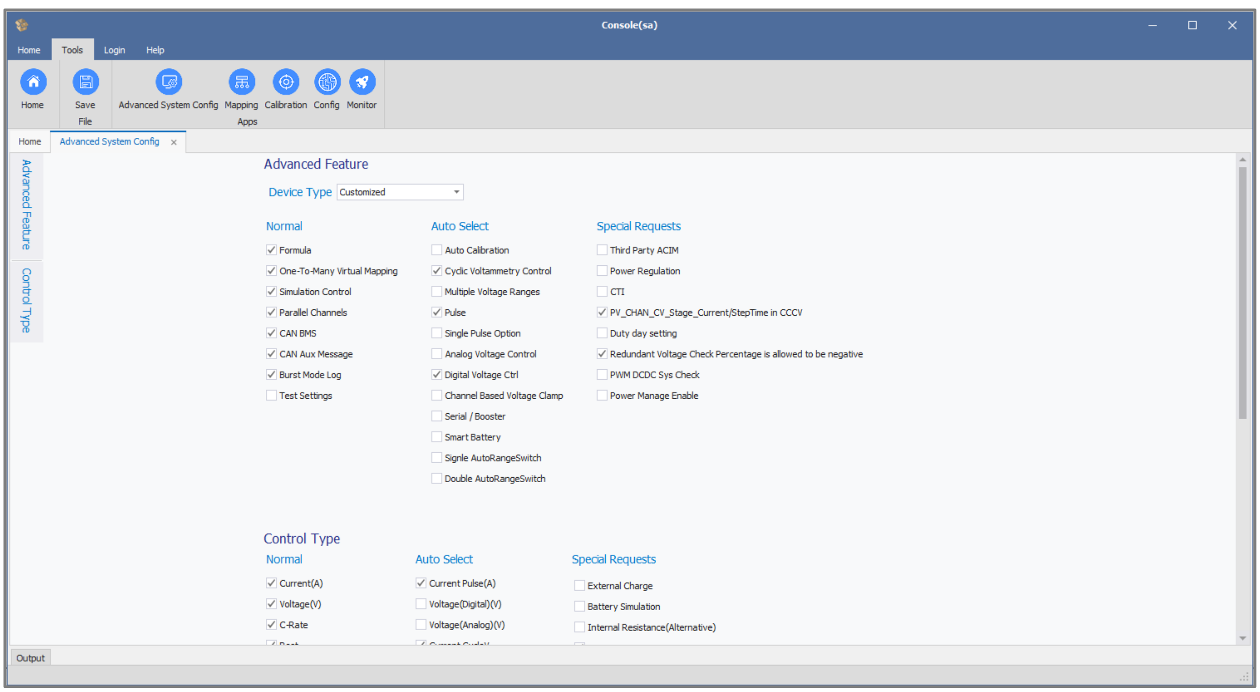


Figure 3-10 Advanced System Config Interface

The **Database Config (Configuration) Interface** is used for setting required functions by device series.

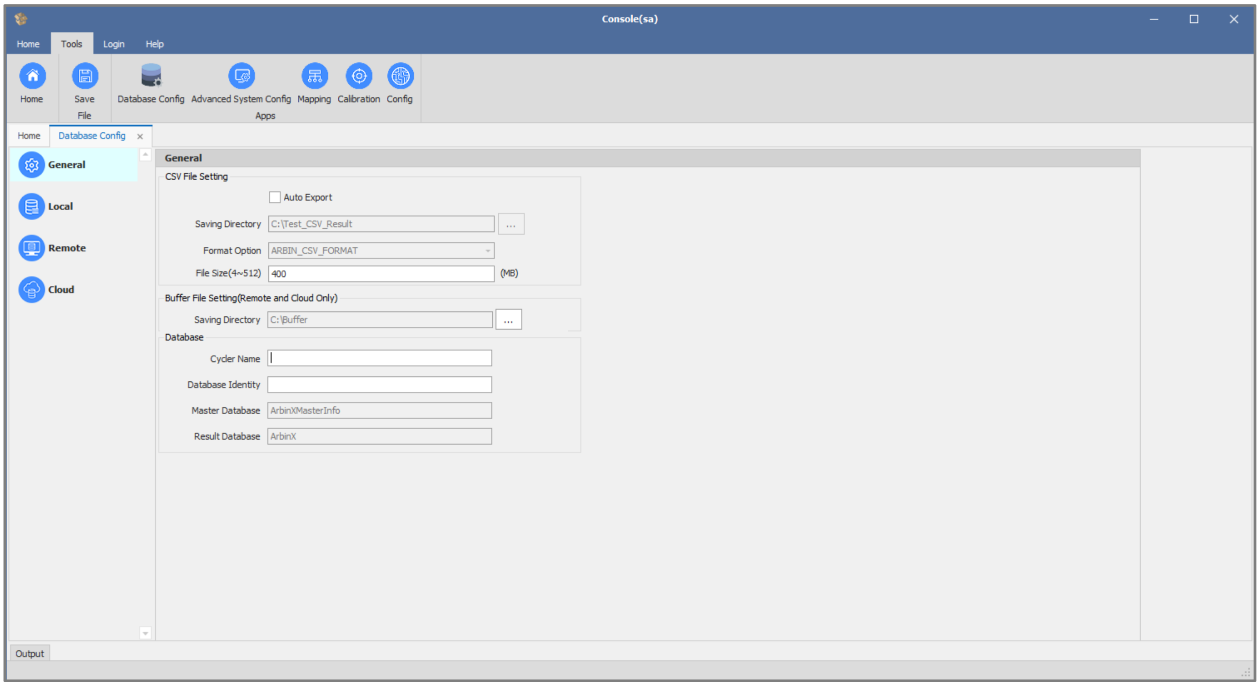


Figure 3-11 The Database Config (Configuration) Interface

The **File Management Interface** is used to backup and restore files.

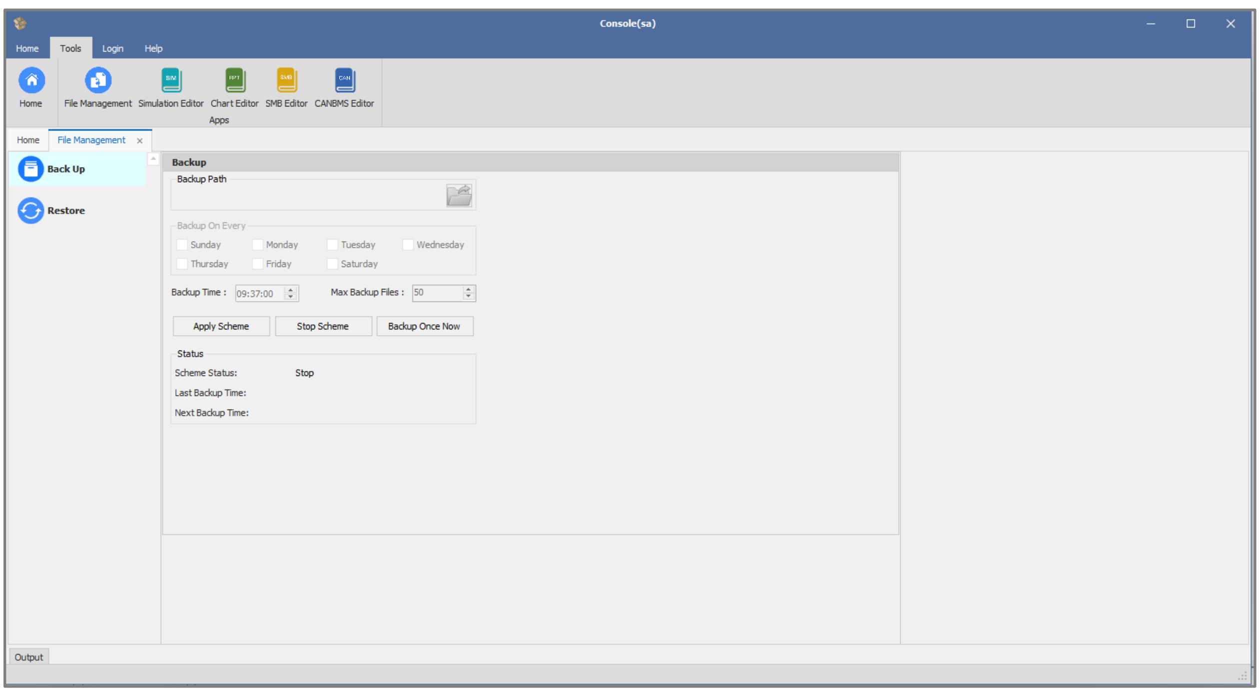


Figure 0-3 File Management interface

The **Schedule Editor** is used for process control. The Schedule File (file extension .sdx) provides information for running tests on batteries or other energy storage devices.

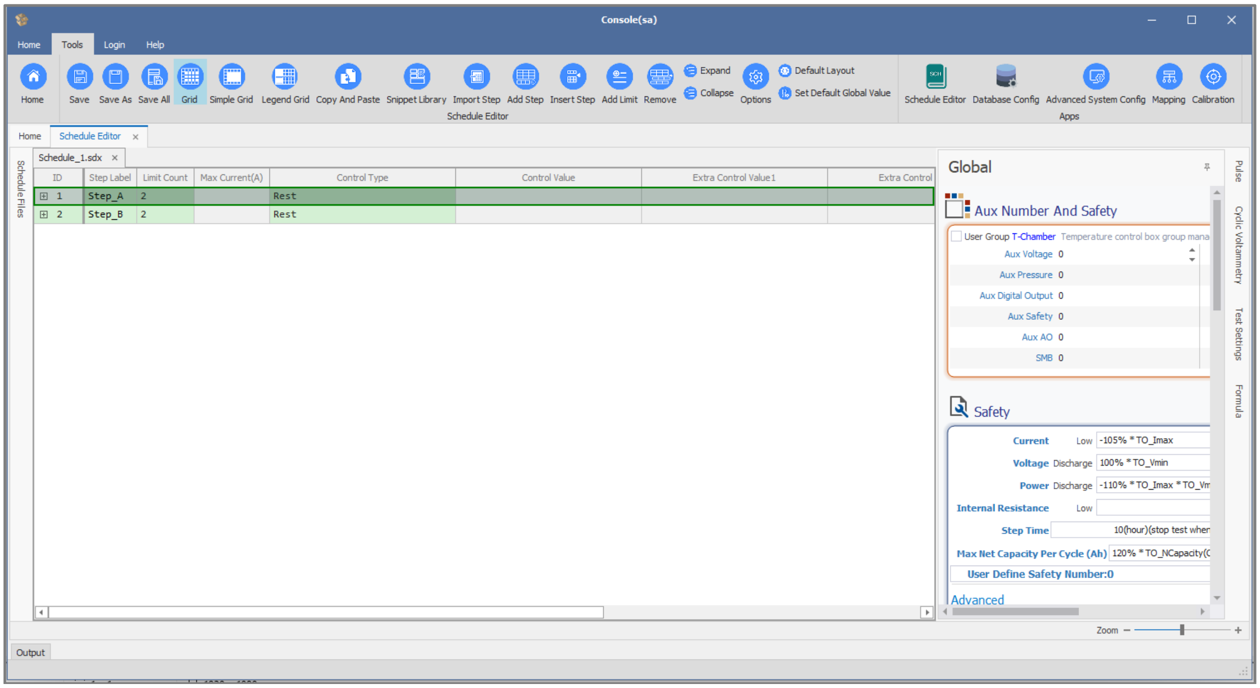


Figure 3-13 The Schedule Editor

The **Test Object Editor** is used for test object information. The Test Object File (file extension (.to) is used to set charge and discharge limits and to identify the test object.

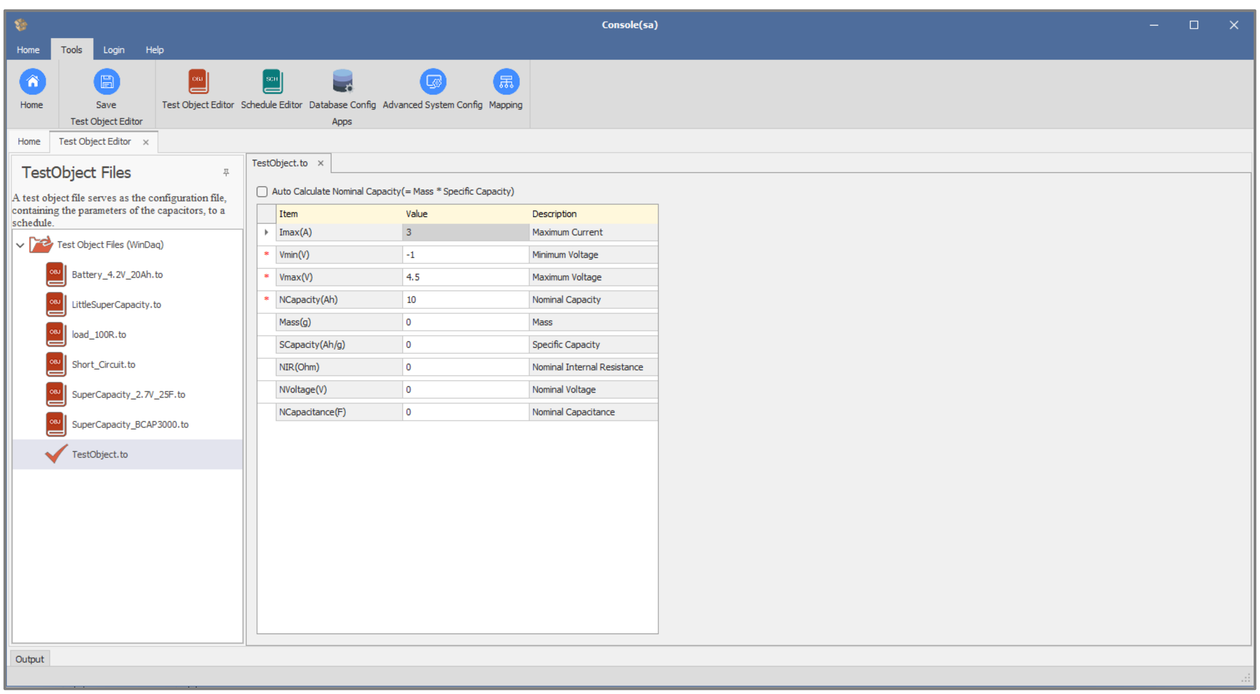


Figure 3-14 The Test Object Editor

The **CAN BMS Editor** is used to edit CAN BMS files, including input CAN signal configuration, output CAN message broadcast, and CAN message formula view.

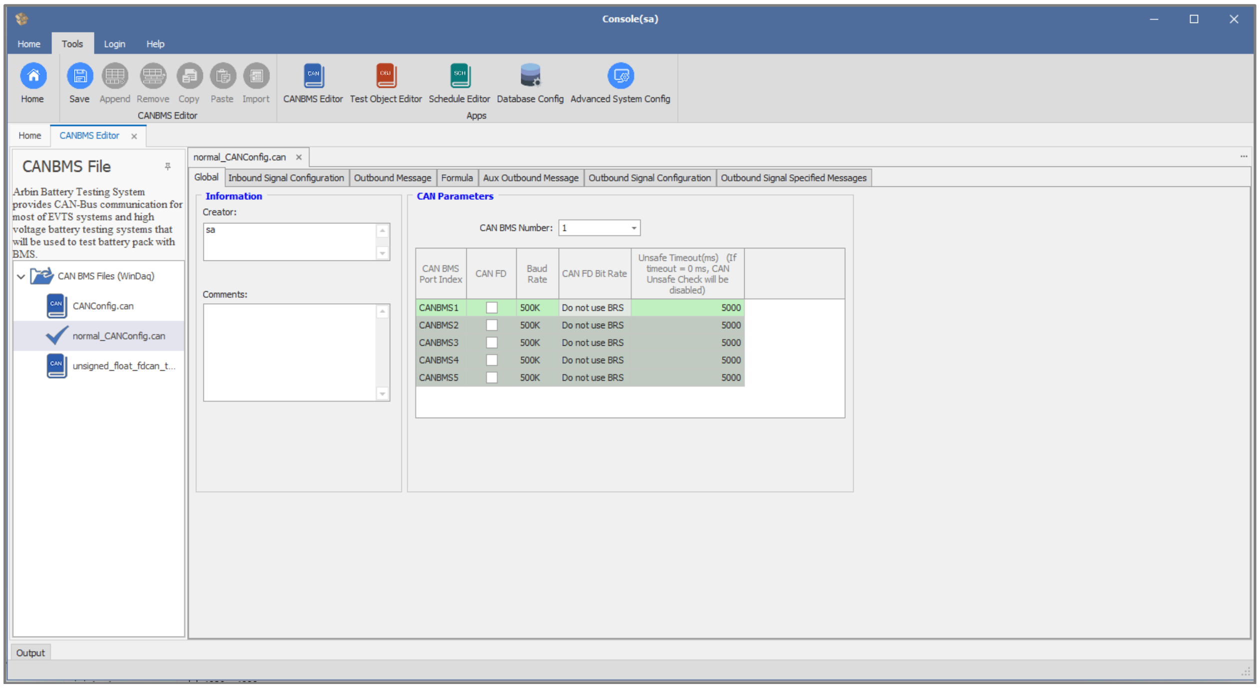


Figure 3-15 The CAN BMS Editor

The **SMB Editor** is used to edit SMB files (file extension .smb), which provide smart battery signal configuration.

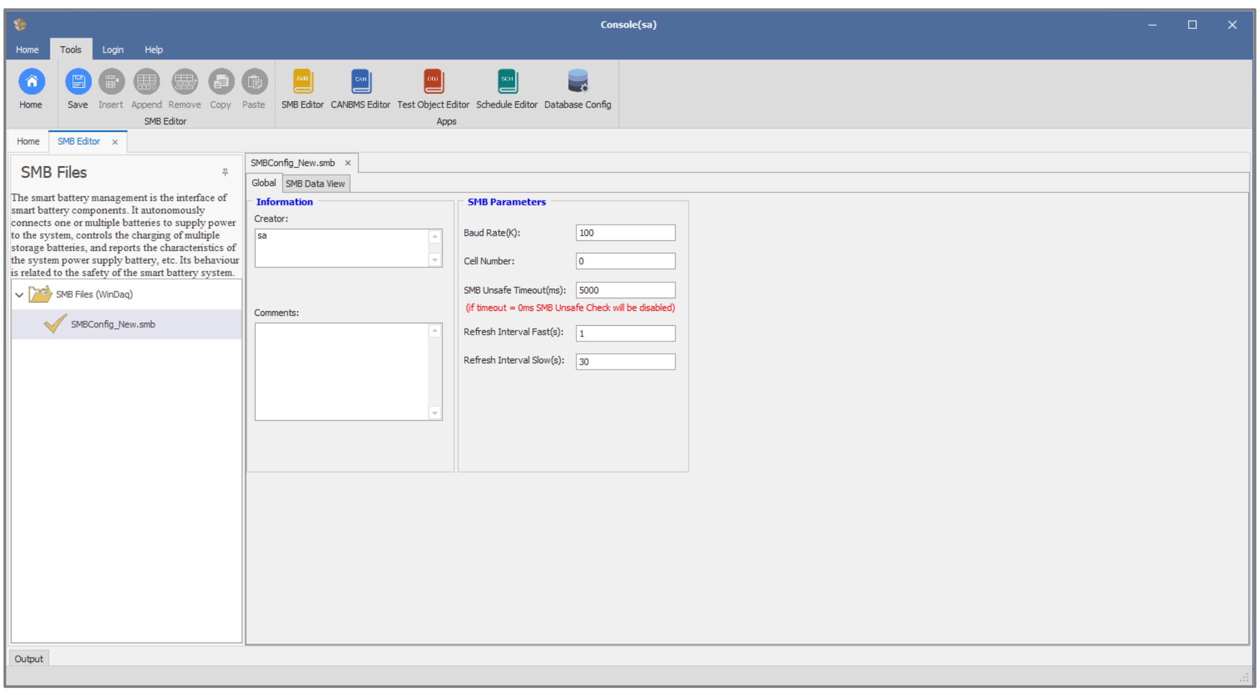


Figure 3-16 The SMB Editor

The **Chart Editor** is used to edit charts in DataWatcher. A Chart File (file extension .cht) provides the settings for DataWatcher.exe.

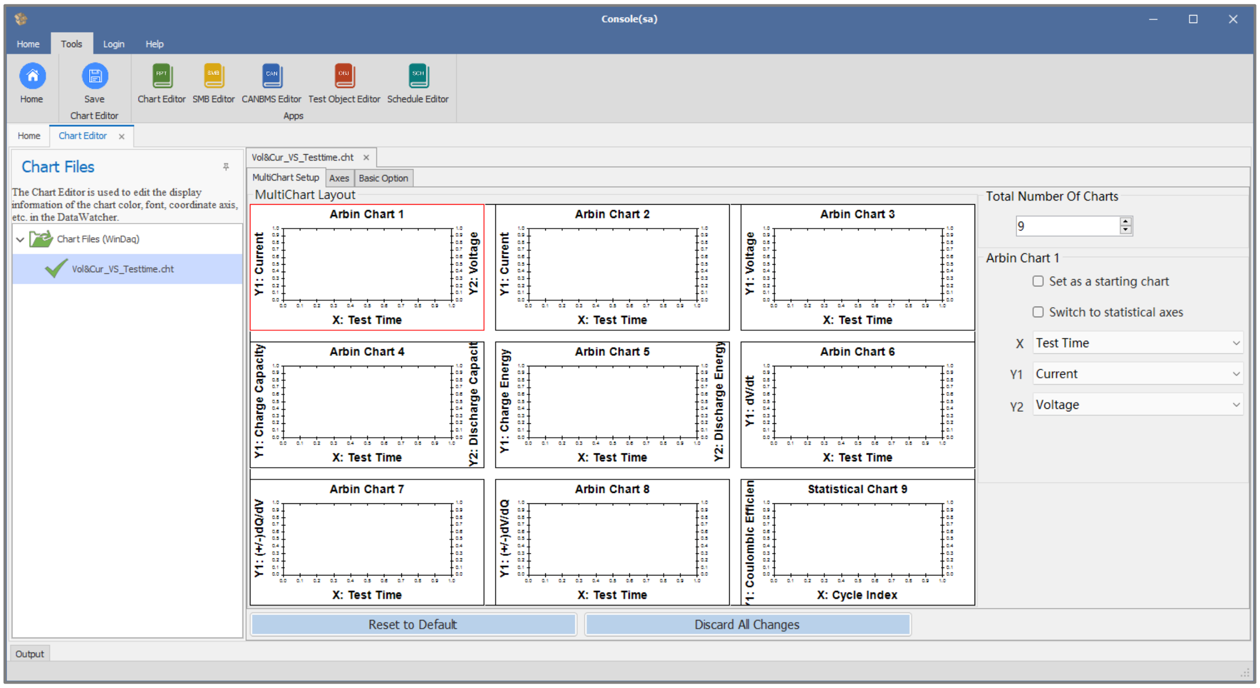


Figure 3-17 The Chart Editor

The **Simulation Editor** is used to configure the Simulation file. BMS files (file extension .can) are provided.

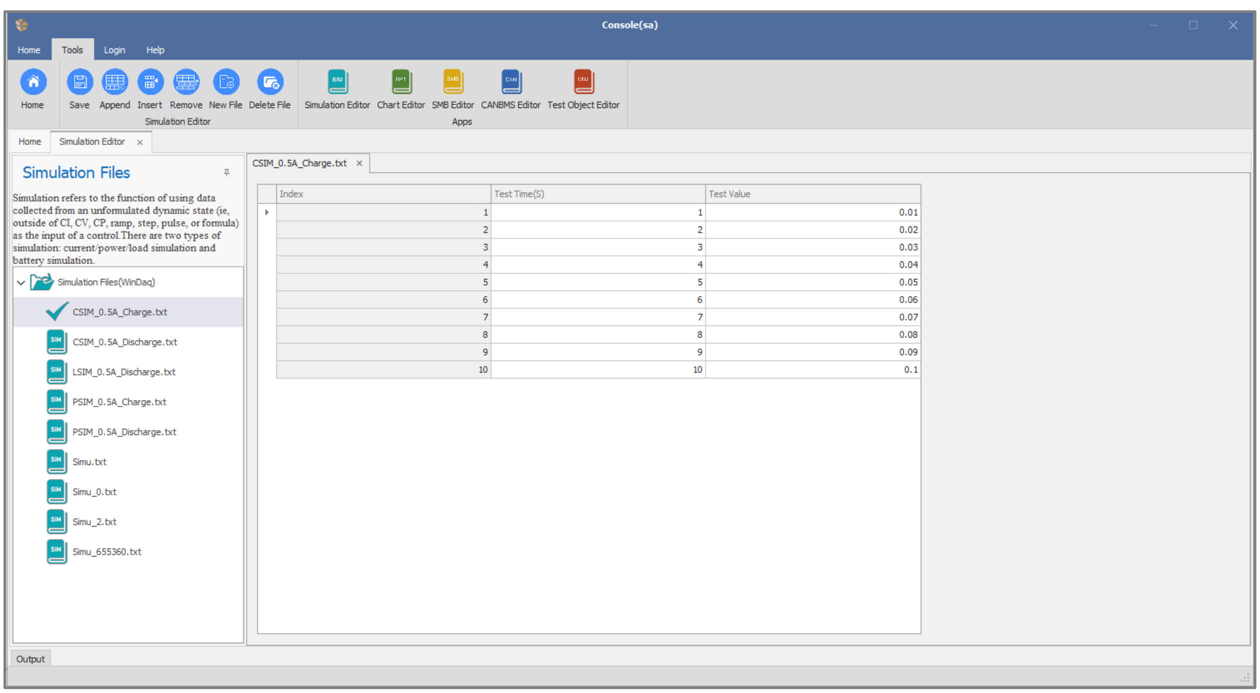


Figure 3-18 The Simulation Editor

DataWatcher is used to view and export data.

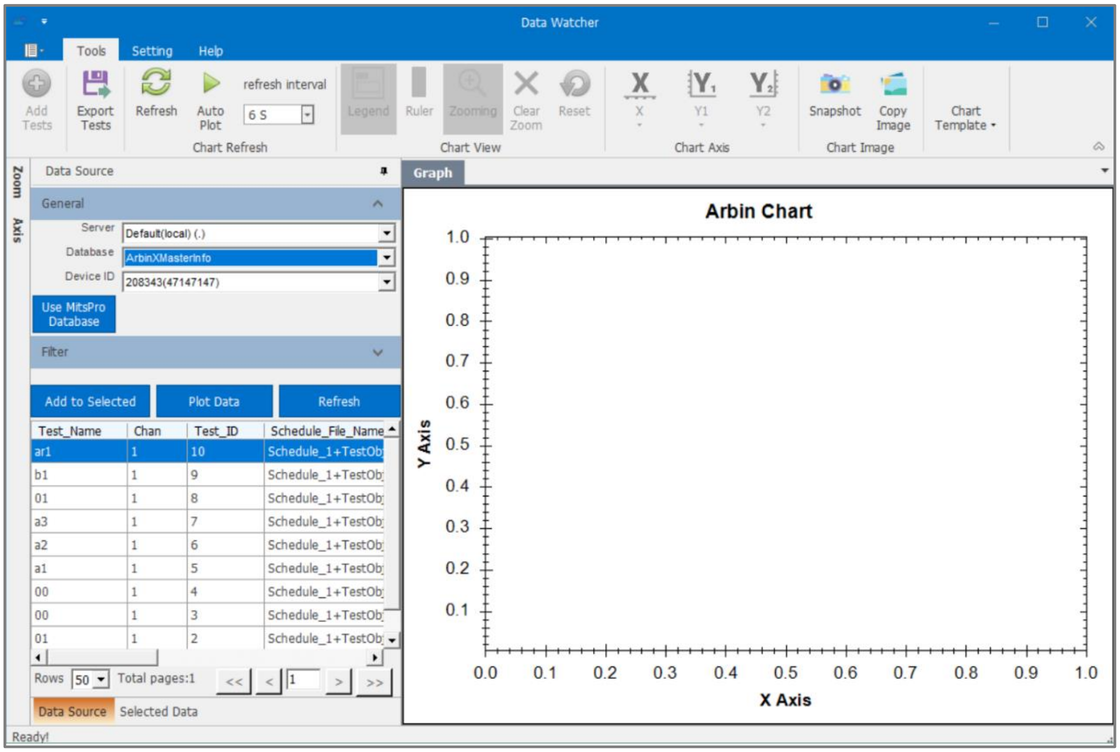


Figure 3-19 The DataWatcher Interface

The **Schedule Migration Interface** is used to manage file migration.

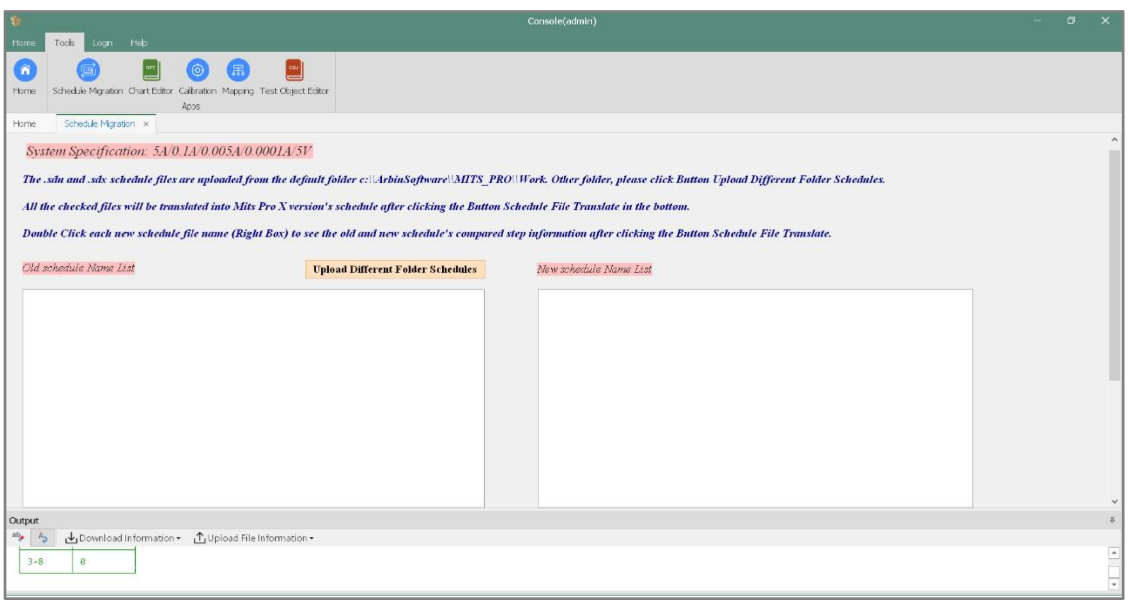


Figure 3-20 The Schedule Migration Interface

4: User Accounts and Permissions

4.1 Introduction to User Accounts and Permissions

4.1.1 Mits X Permission Levels

The Mits X software allows for different user capabilities and restrictions at different permission levels. There are four distinct permission levels in Mits X.

1) **Guest:** The "Guest” account has “ready-only” permissions for any Mits X files. Guest-level accounts have no editing or test operation permissions.
2) **Operator:** By default, accounts at the “Operator” level are able only to run and edit Tests.
3) **Administrator:** An “Administrator” account can manage devices and edit schedule files, Mapping Files, and other Mits X files.
4) **Manufacturer:** The “Manufacturer” account has the highest level of user permissions. This account level is reserved for Arbin and used internally to configure machine hardware and system-level information.

Multiple accounts can be assigned to the Operator and Administrator permission levels, based on distinct usernames and passwords. Additional details on user accounts and permission levels are provided in the following sections of this chapter.

4.1.2 Permission Level Details

The capabilities and restrictions at each permission level are defined by the following operation modules:

1) **Editing System Config File:** Modify the ArbinSys.cfg file.
2) **Editing the Mapping File:** Modify the ArbinSys.bth file.
3) **Channel Assign Schedule:** Assign a Schedule File to the channel.
4) **Conducting Tests:** Conduct the test in the Monitor Interface, including the ability to start, jump to, stop, and resume a test.
5) **Setup SQL Settings:** Modify the settings in ArbinSys.DBCF file.
6) **PWM Config:** This function is currently under development.

Operation Capabilities by Permission Level

1) **Manufacturer:** All above operations; settings cannot be modified.
2) **Administrator:** The following operations, all of which are optional and can be modified:
3) Editing the Mapping File
4) Channel Assign Schedule
5) Conducting Tests
6) Conducting Calibration
7) Setup SQL Settings
8) PWM Config

9) **Operator:** The following operations, all of which are optional and can be modified:
10) Editing the Mapping File
11) Channel Assign Schedule
12) Conducting Tests
13) Conducting Calibration
14) **Guests:** The Guest account is view-only and does not have access to any of the above operations.

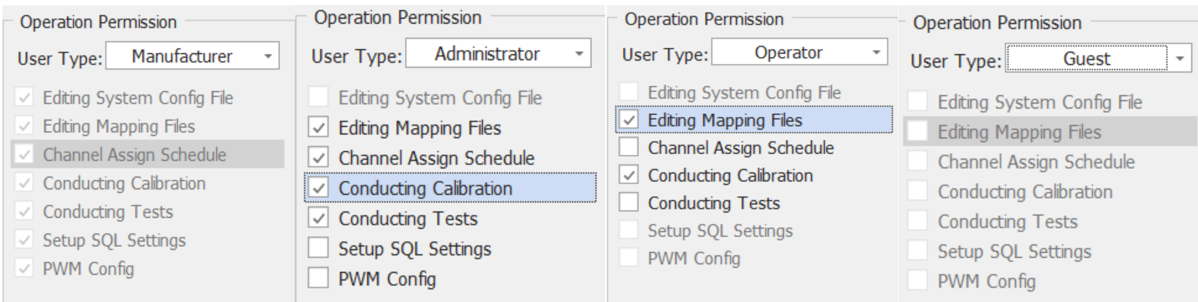


Figure 4-1 Functions and Capabilities by Permission Level

4.2 Manage User Accounts and Permissions

4.2.1 The Permission Management Interface

Open the Permission Management Interface

1) In Mits X, click the "Login" option on the main menu.
2) Click the "Permission Management" icon to open the Permission Management Interface.

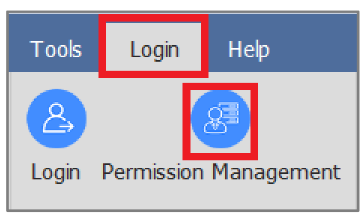


Figure 4-2 Login and Permission Management Icon

Functions of the Permission Management Interface

The Permission Management interface has two functions:

1) Operation Permission – Located on the left of the Permission Management Interface, allows user to edit the operation permissions for each permission level.

NOTE: Lower-level accounts cannot edit higher-level operation permissions. For example, Administrator-level users cannot modify User Type, which is a Manufacturer-level operation.

2) User Management – Located on the right of the Permission Management Interface, allows user to manage, edit, add, and delete users.

4.2.2 Add a User Account

1) Under Operation Permissions, right-click on any user record to open the menu bar for managing user accounts.
2) Select “Add User” from the menu that appears to open the Add User Interface.
3) Enter the username and password.
4) Select the user type and channel permissions.
5) Enter the account description and complete other fields (optional).
6) Click the “Ok” button to save the new user account.

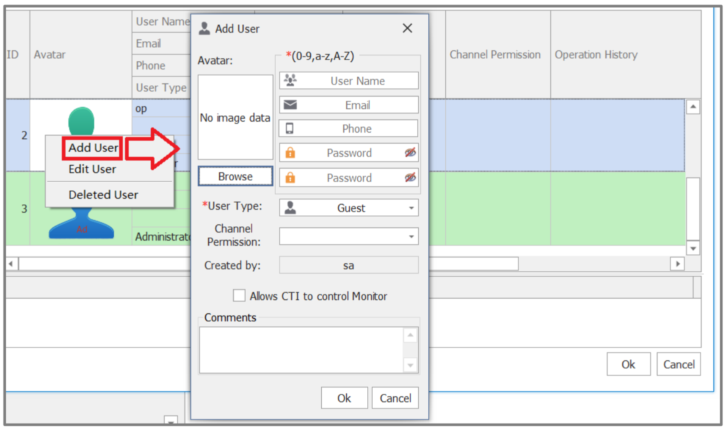


Figure 4-3 Add User Interface

4.2.3 Edit a User Account

1) Right-click on user record you want to edit to open the menu bar.
2) Select “Edit User” from the menu that appears.
3) Make any needed changes to the user account information, including password, user type, channel permission, and account description.
4) Click the “Ok” button to save changes to the user account.

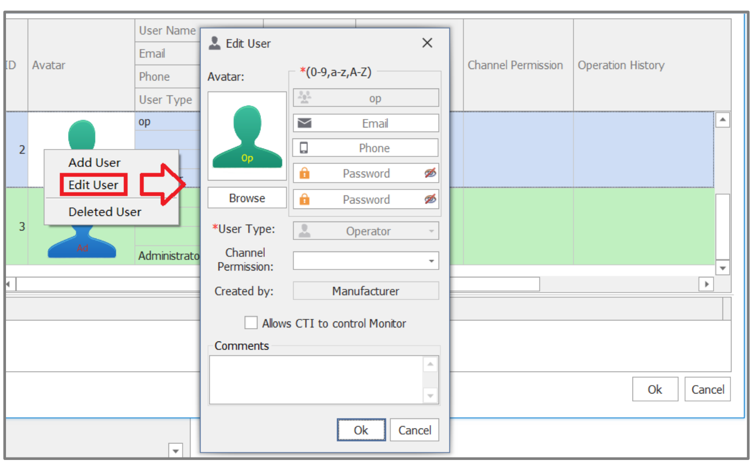


Figure 4-4 Edit User Interface

NOTE: The scope of modification varies for different account levels. For example, Administrator-level accounts cannot modify the user type to Manufacturer.

4.2.4 Delete a User Account

1) Right-click on user record you want to delete to open the menu bar.
2) Select "Delete User" from the menu that appears.
3) Click the "OK" button to delete the user account.

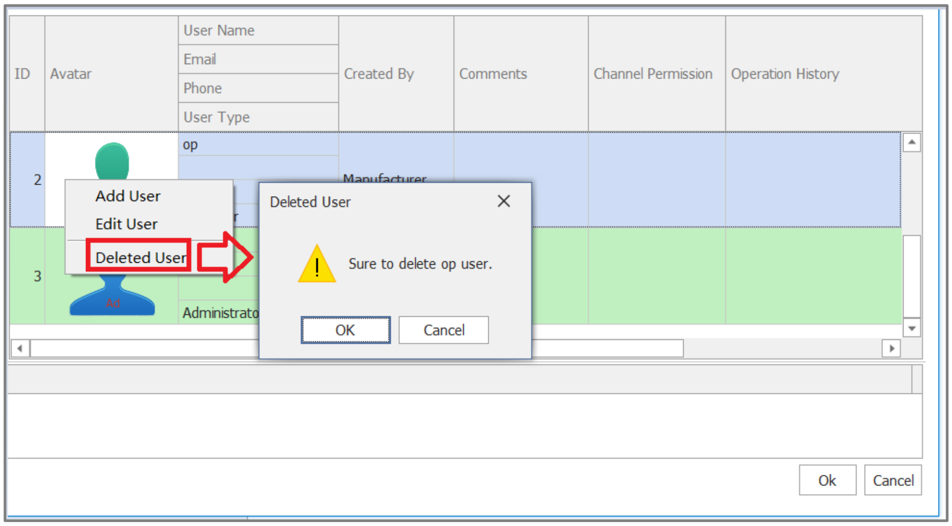


Figure 4-5 Delete User

NOTE: The accounts with usernames "admin," "op," and "guest cannot be deleted. Also, Administrator-level accounts cannot be deleted by Manufacturer-level accounts.

5: Test Object Files

5.1 Introduction to Test Object Files

5.1.1 What is a Test Object File?

The Test Object File is a configuration file for testing and is used to set the load parameters for the test. These include Maximum Current, Minimum/Maximum Voltage, Nominal Capacity, Mass, Specific Capacity, Nominal Internal Resistance, Nominal Voltage, and Nominal Capacitance.

5.1.2 The Test Object Editor

Open the Test Object Editor

1) Open Mits X.
2) On the Mits X home screen, double-click on the "Test Object Editor" icon to open the Test Object Editor.

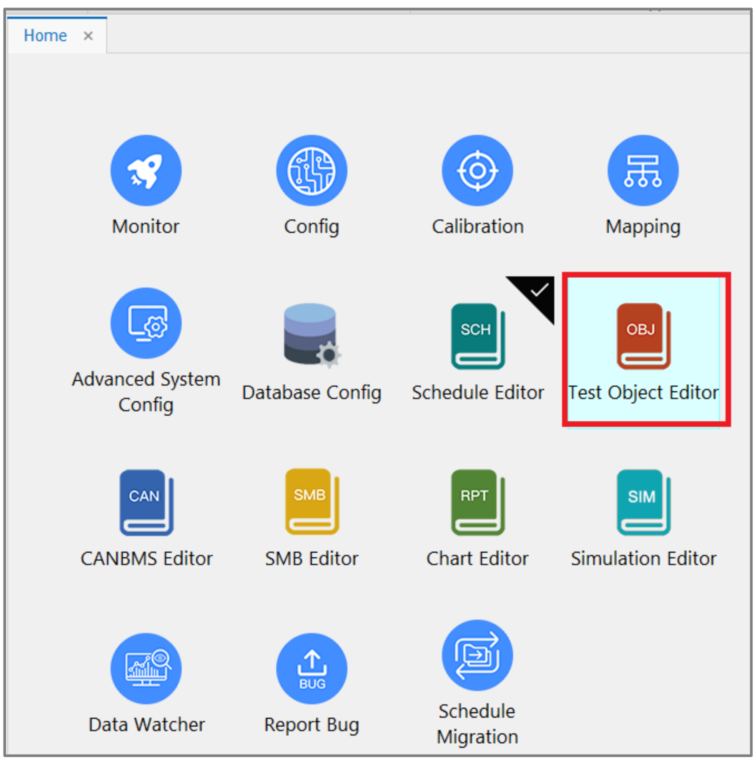


Figure 5-1 The Test Object Editor Icon

Open the Test Object Editor Locally

1) On the Mits X home screen, right-click on the "Test Object Editor" icon.
2) Click on the "Open this app locally" option that appears to open the Test Object Editor locally.

Figure 5-2 Open the Test Object Editor Locally

The Test Object Editor

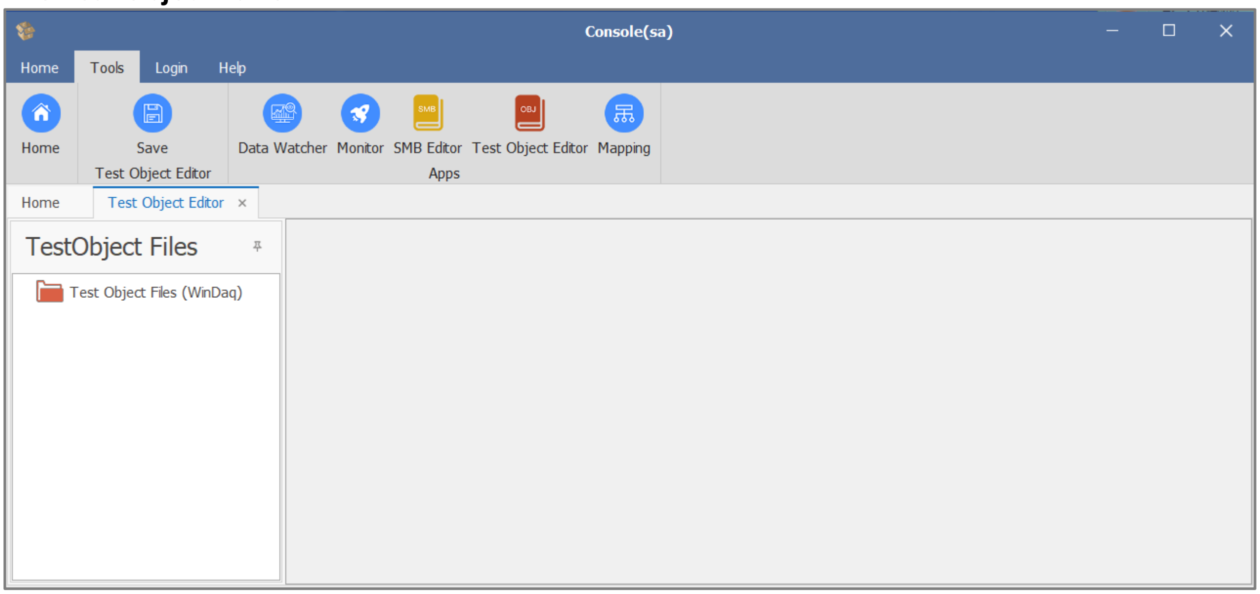


Figure 5-3 The Test Object Editor

5.2 Manage Test Object Files

5.2.1 Create a New Test Object File

1) Right-click the Test Object Files under the directory Interface.
2) Select the “New File” option on the menu that comes up to create a Test Object file.
3) The new Test Object file will open automatically.

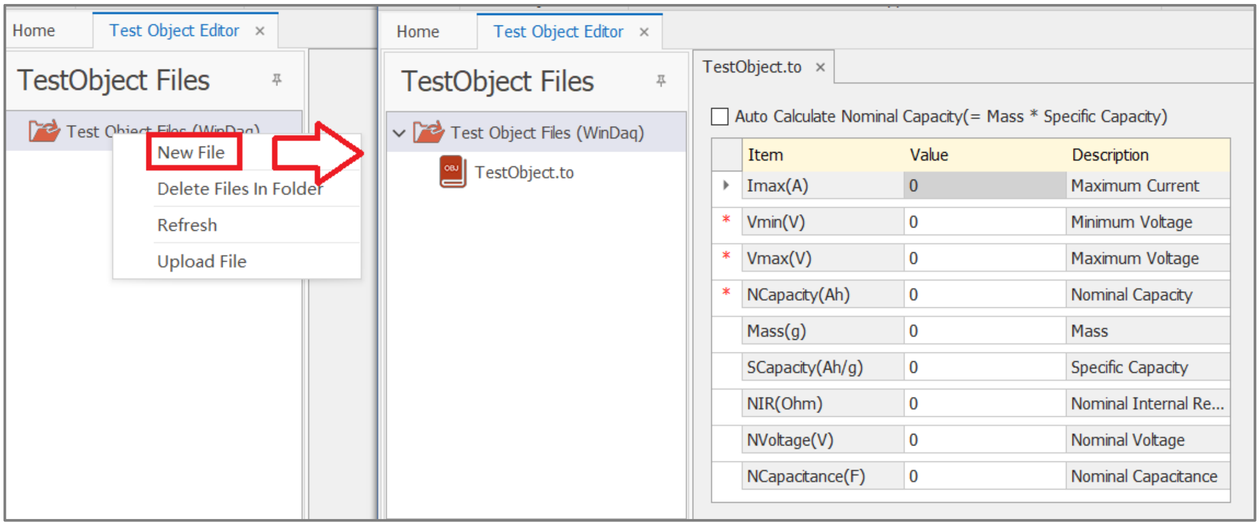


Figure 5-4 Create a New Test Object File

5.2.2 Open a Test Object File

There are two methods to open an existing Test Object File:

1) Left-click the Test Object File you want to open under the directory Interface.
2) Right-click the Test Object File you want to open and select the “Open” option on the menu that comes up to open the file.

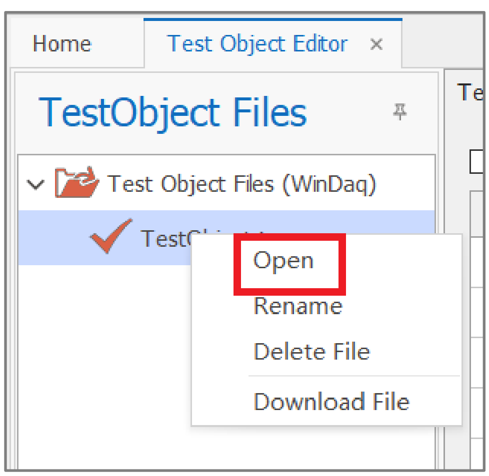


Figure 5-5 Open a Test Object File

5.2.3 Upload a Test Object File

1) Right-click the Test Object Files under the directory Interface.
2) Select the "Upload File" option on the menu that comes up.
3) Select the file you want to upload.
4) Click "OK" to complete the upload of the Test Object File.

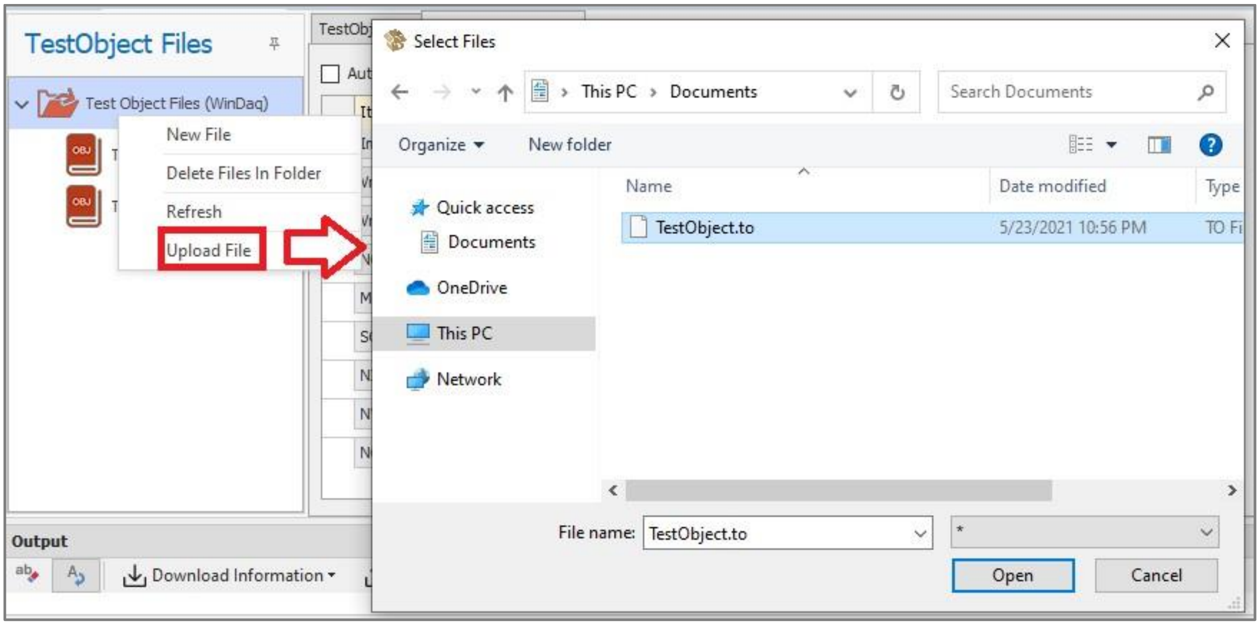


Figure 5-6 Upload a Test Object File

5.2.4 Edit a Test Object File

1) Open the "Test Object File."
2) Click the input box under the "Value" column.
3) Type in the desired value.
4) Check the statement above the table to automatically calculate the Nominal Capacity value. The calculation formula for this is Nominal Capacity = Mass*Specific Capacity.

☐ Auto Calculate Nominal Capacity(= Mass * Specific Capacity)

	Item	Value	Description
*	Imax(A)	10	Maximum Current
*	Vmin(V)	-5	Minimum Voltage
*	Vmax(V)	5	Maximum Voltage
*	NCapacity(Ah)	10	Nominal Capacity
▸	Mass(g)	0	Mass
	SCapacity(Ah/g)	0	Specific Capacity
	NIR(Ohm)	0	Nominal Internal Resistance
	NVoltage(V)	0	Nominal Voltage
	NCapacitance(F)	0	Nominal Capacitance

Figure 5-7 Edit a Test Object File

5.2.5 Rename a Test Object File

1) Right-click the Test Object File to be renamed under the directory Interface.
2) Select the “Rename File” option on the Interface that comes up.
3) Enter the new file name in the Name Input box.
4) Click “OK” to confirm the file name change.

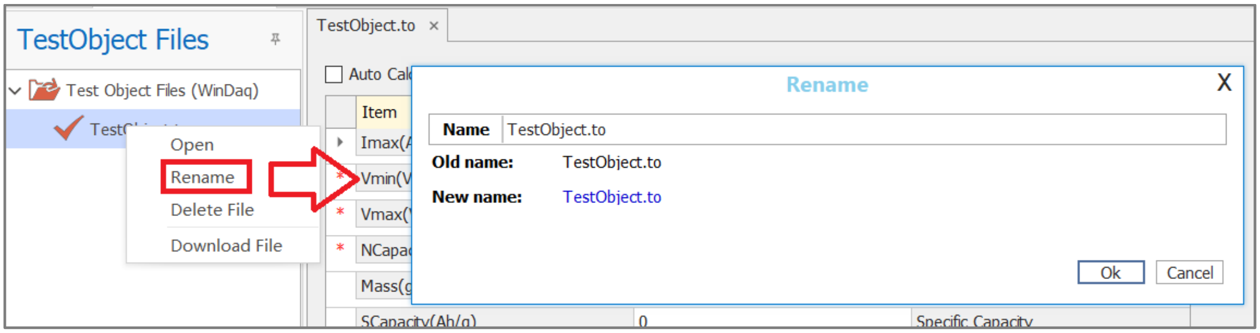


Figure 5-8 Rename a Test Object File

5.2.6 Download a Test Object File

1) Right-click the Test Object File you want to download under the directory Interface.
2) Select the “Download File” option on the menu that comes up.
3) Select the destination path for saving the Test Object File.
4) Click “OK” to complete the download of the Test Object File.

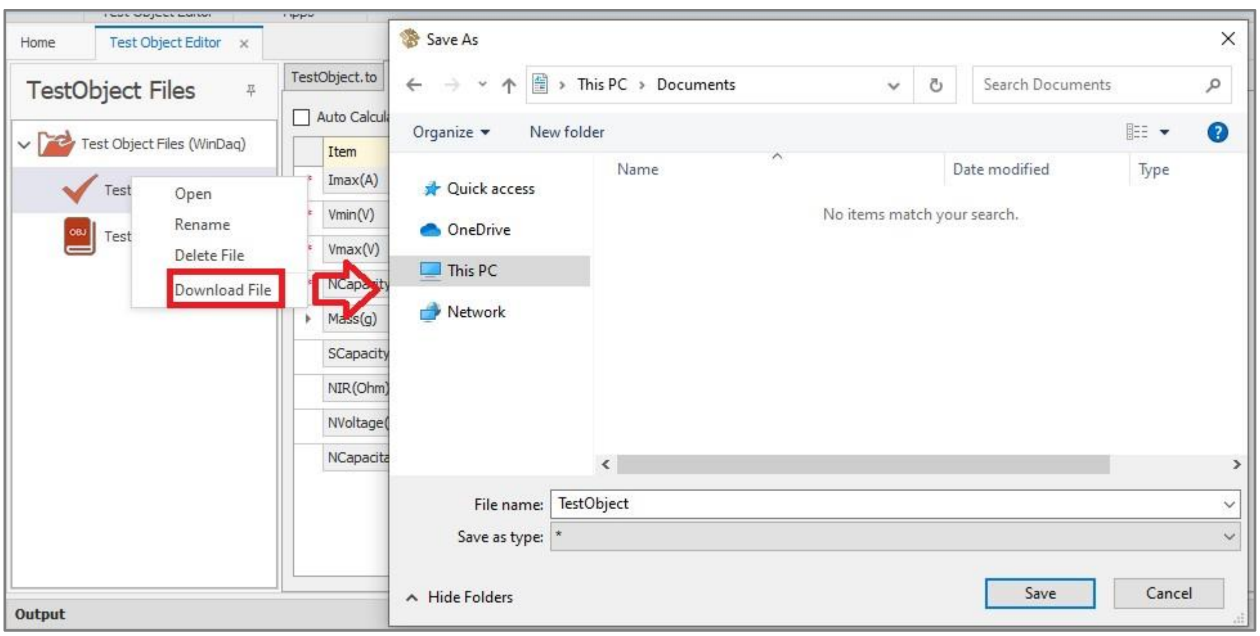


Figure 5-9 Download a Test Object File

5.2.7 Delete a Test Object File

1) Right-click the Test Object File to be deleted under the directory Interface.
2) Select the “Delete File” option on the Interface that comes up.
3) Click “OK” in the pop-up Interface that appears to delete the selected Test Object File.

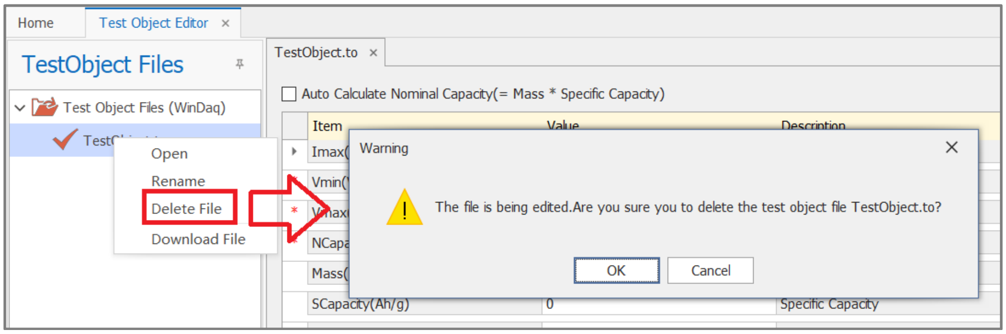


Figure 5-10 Delete a Test Object File

5.3 Mange the Test Object File Directory

5.3.1 Refresh the Test Object File Directory

1) Right-click the Test Object Files under the directory Interface.
2) Select the “Refresh” option on the menu that appears to refresh the Directory.

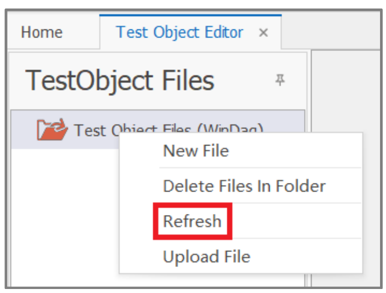


Figure 5-11 Refresh the Test Object File Directory

5.3.2 Delete All Test Object Files in the Directory

1) Right-click the Test Object Files under the directory Interface.
2) Select the “Delete Files in Folder” option on the menu that comes up.
3) Click “OK” in the pop-up Interface that appears to delete all Test Object Files.

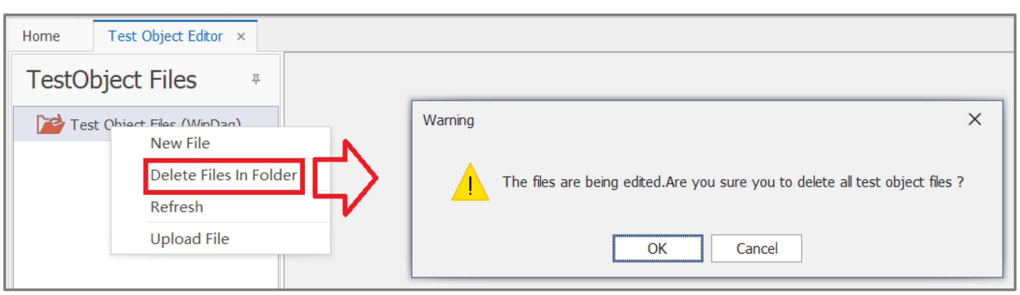


Figure 5-12 Delete All Test Object Files in the Directory

6: Schedule Files

6.1 Introduction to Schedule Files

6.1.1 What is a Schedule File?

A Schedule is a user-defined test procedure made up of sequential Steps. A Schedule File (file extension .sdx) may consist of as many steps as desired and can be assigned to any channel once the Schedule is defined.

A single Step in a Schedule contains the following elements:

1) A controlling test function and its value
2) The termination conditions for the Step
3) The next step that testing is scheduled to go to when the present Step is finished
4) Data logging criteria

A Schedule file is divided up into six pages depending on the system configuration options. These pages are: Global, Step, Formula, Pulse Cyclic Voltammetry, and Test Setting.

All Schedule pages will not be applicable to all test systems. For example, the Test Setting page only applies to systems with MTCI, AIAO, and DIDO devices.

6.1.2 The Schedule Editor

Open the Schedule Editor

1) Open Mits X.
2) On the main menu, double-click on the “Schedule Editor” icon to open the Schedule Editor.

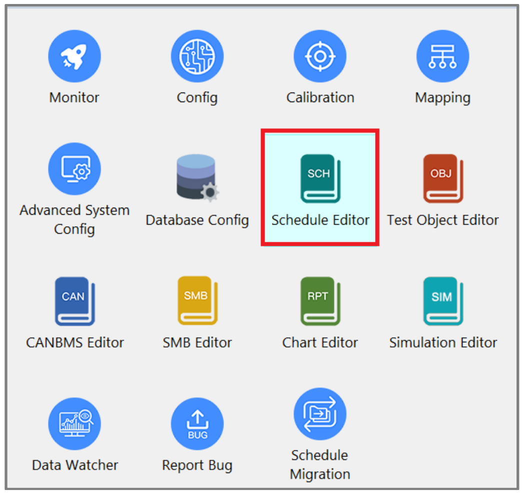


Figure 6-1 The Schedule Editor Icon

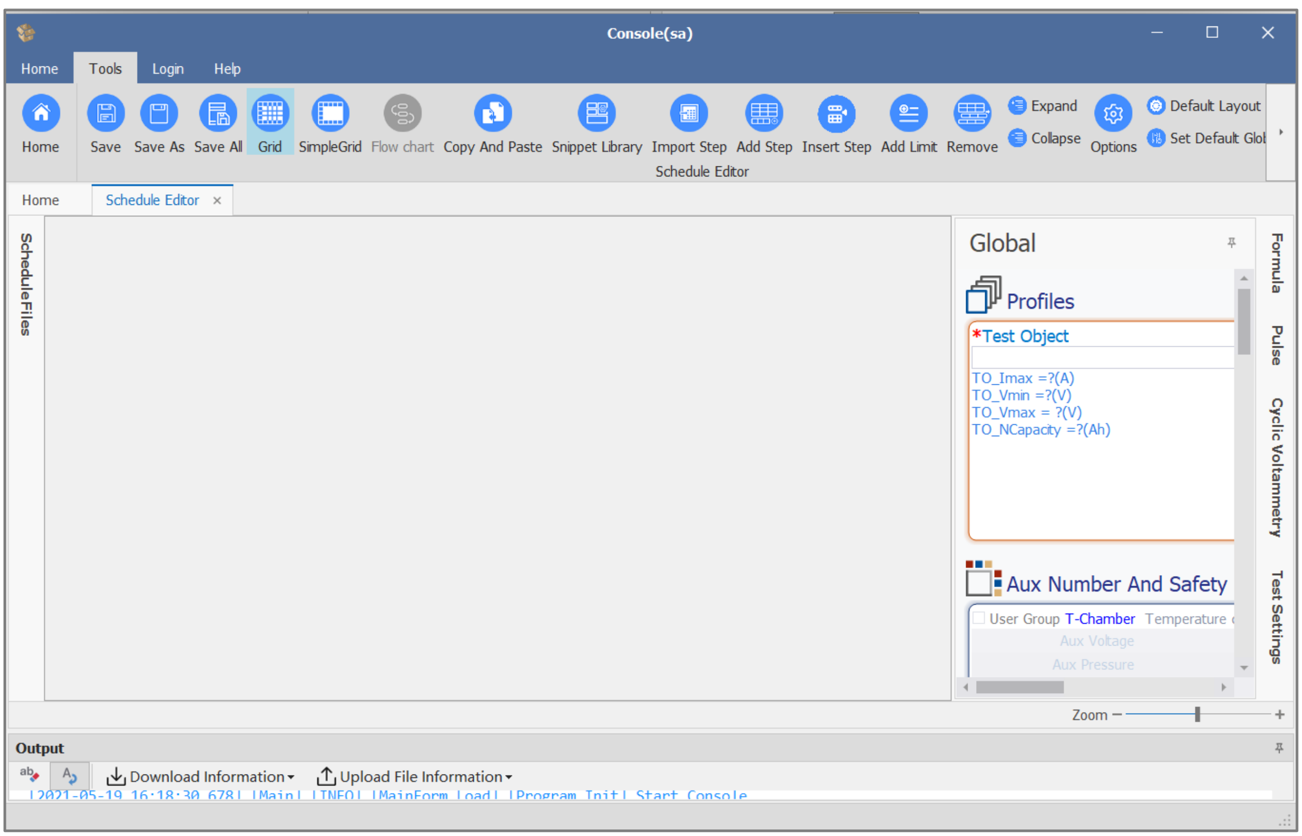


Figure 6-2 The Schedule Editor

6.1.3 The Schedule File Toolbar

The Schedule File Toolbar provides easy access to several key Schedule File functions.

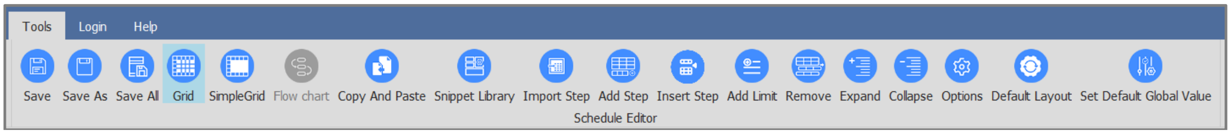


Figure 6-3 The Schedule Editor Toolbar

Save/Save As/Save All

1) **Save** – Click on the “Save” icon to save a Schedule File that you are editing.
2) **Save As** – Save the current Schedule File to a specific location.
   a) Click on the “Save As” icon to open the "Save As” input box.
   b) Select the location where you want to save the file.
   c) Click in the “Name” input box to edit the name of the Schedule File.
   d) Click the “OK” button to save the Schedule File.

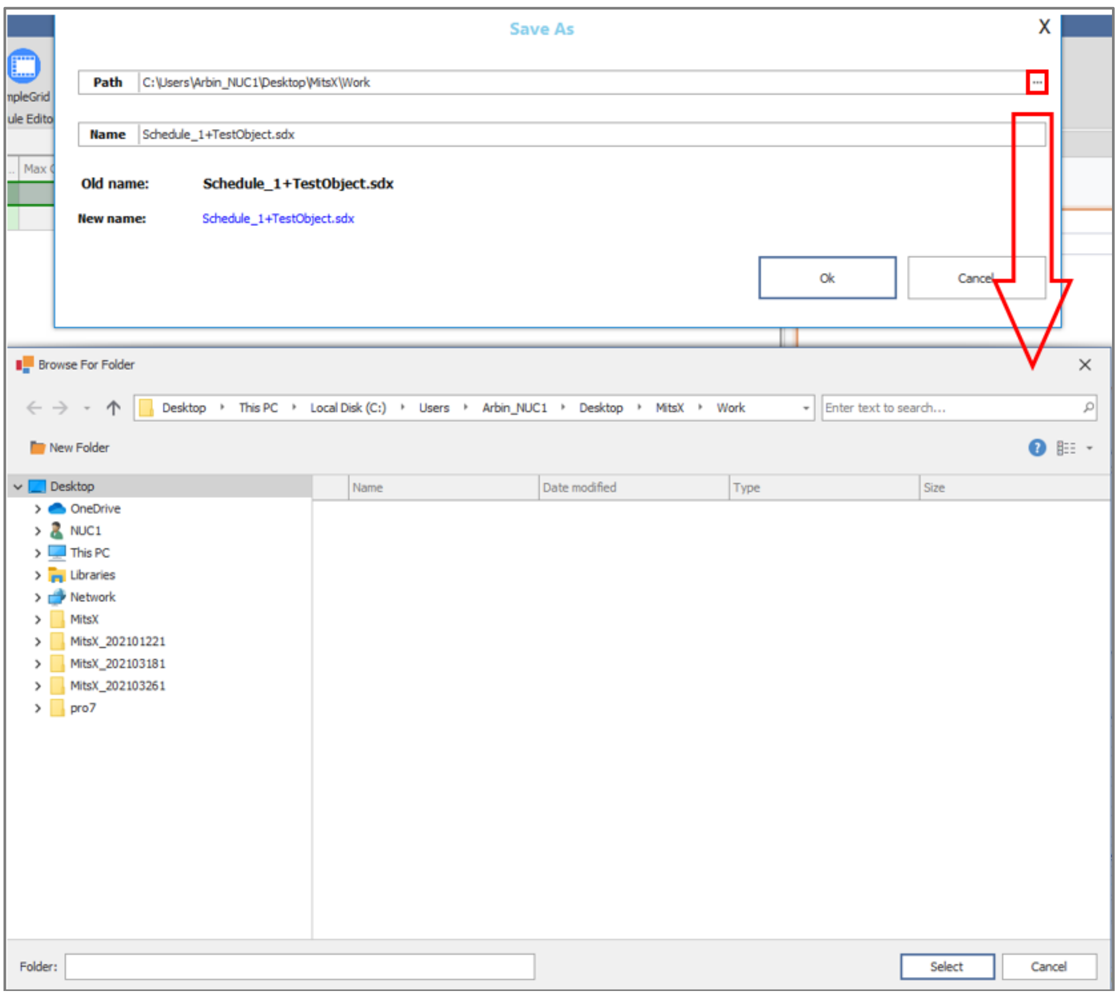


Figure 6-4 Save As in the Schedule Editor

3) **Save All** – Click on the “Save All” icon to save all opened Schedule Files with one click.

Grid/Simple Grid/Flow Chart

4) **Grid** – Click on the “Grid” icon on the Schedule File Toolbar to use the Grid Mode for editing.

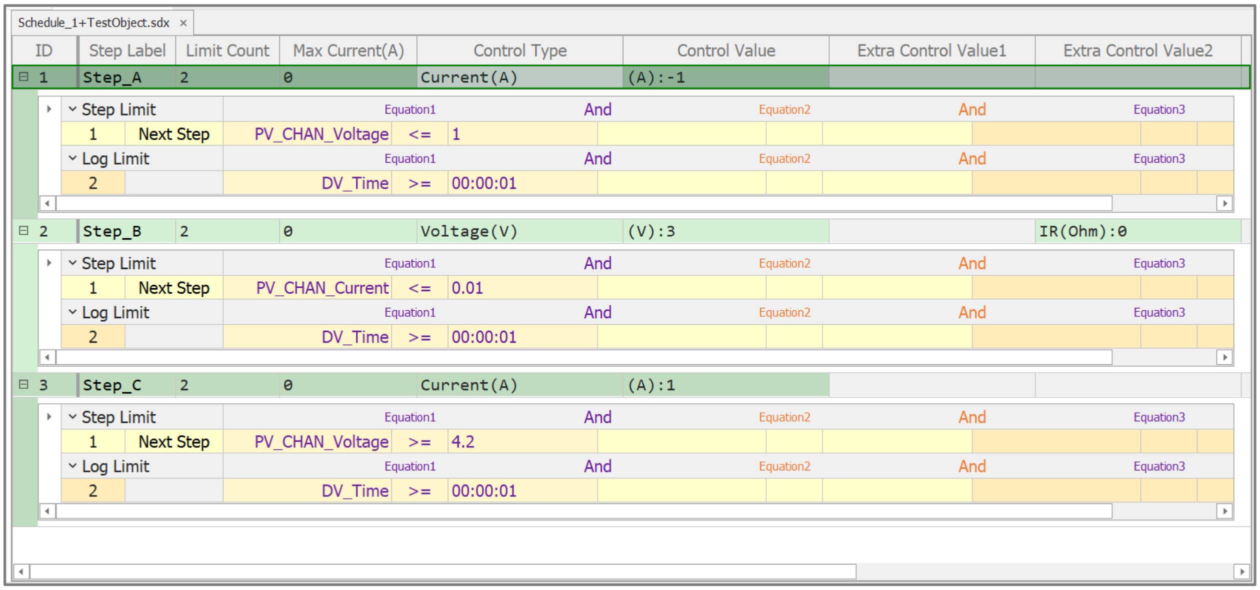


Figure 6-5 Grid Mode

5) **Simple Grid** – Click on the “Simple Grid” icon on the Schedule File Toolbar to use the Simple Grid Mode for editing.

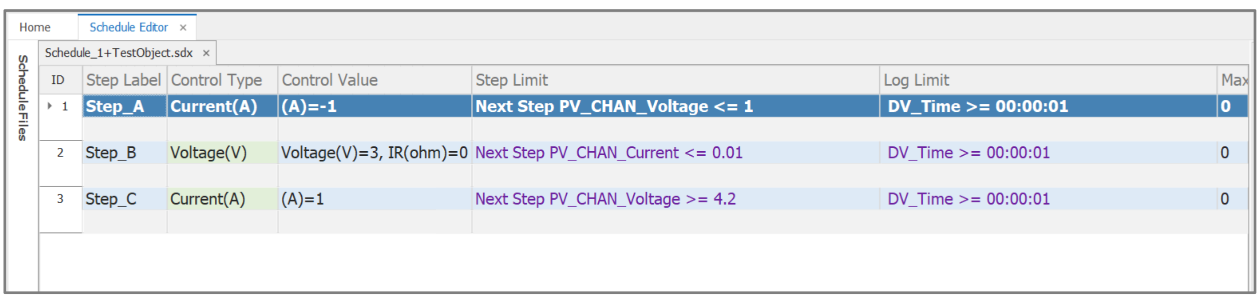


Figure 6-6 Simple Grid Mode

6) **Flow Chart** – This editing mode is temporarily not supported.

Copy and Paste Step/Limit

7) **Copy and Paste** – Copy and Paste Steps and Limits.
   a) Click on the "Copy and Paste" icon in the Schedule File Toolbar to open the Copy and Paste Interface.
   b) Select the Step or Steps that you want to copy.
   c) Select the elements you want to copy.
      i) **Step & Limit** – Copy the contents of both Step and Limit at the same time.
      ii) **Step Only** – Copy only the contents of the Step.
      iii) **Limit Only** – Copy only the contents of the Limit.
   d) Select the limit range you want to copy.
   e) Choose how you want to copy the Limit.
      i) **Overwrite** – Overwrite the current Limit.
      ii) **Append** – Attach a new Limit to the current Limit.
      iii) **Insert** – Click Insert the new Limit before the current Limit.
   f) Select the Steps where the copied Steps should be Pasted. To select a single step, for example Step C, select From Step C to Step C. To select multiple steps, for example, Steps B to D, select From Step B to Step D.
   g) Click the "Paste" button to Paste the copied Steps and Limits.

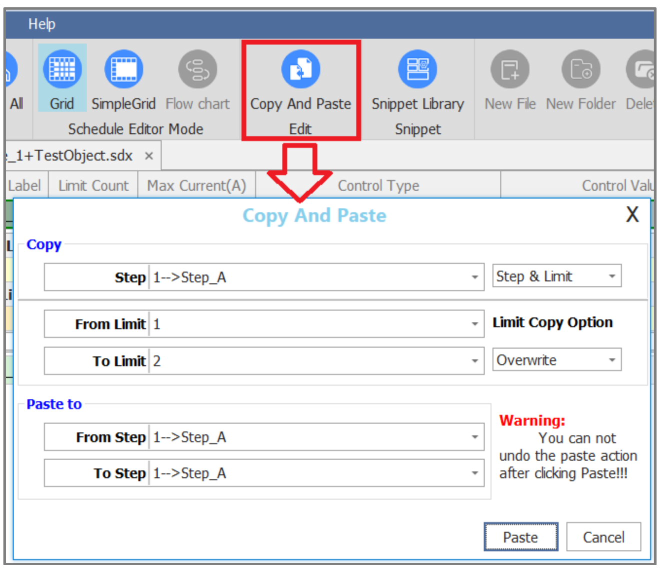


Figure 6-7 Copy and Paste Step/Limit

NOTE: Copy and Paste is temporarily not supported in Simple Grid Mode.

Snippet Library

8) **Snippet Library** –Save a Step or Steps as a snippet in the library for later reuse.
   a) Create a snippet in the Snippet Library.
      i) Right-click on the Step or Steps you want to save as a snippet to open the Create Snippet Interface.
      ii) In the Create Snippet Interface, enter a Group Name for the snippet. Steps from the same Group will be added to the Schedule together.
      iii) Enter a Nickname for the snippet to make it easier to find and distinguish from other snippets.
      iv) Enter a Comment to describe the snippet, if desired.
      v) Click the "OK" button to save the snippet to the Snippet Library.

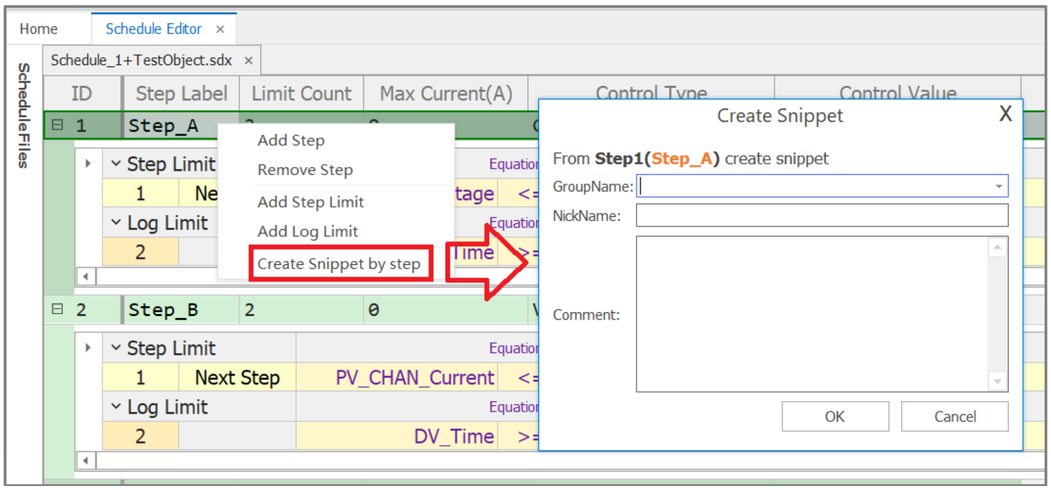


Figure 6-8 Create a Snippet

   b) Use a Step or Steps from the Snippet Library.
      i) Click on the "Snippet Library" icon in the Schedule File Toolbar to open the Snippet Library.

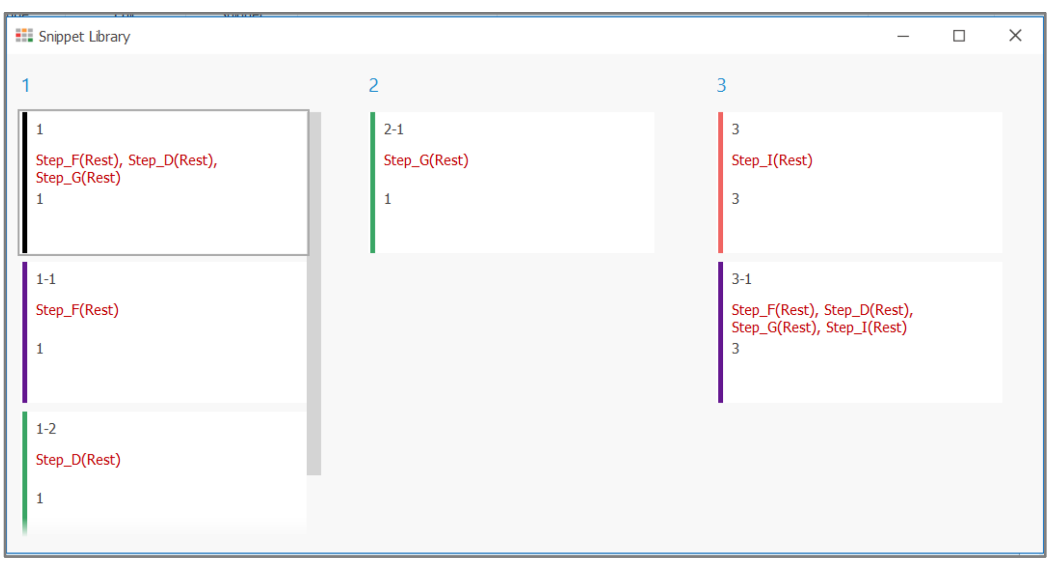


Figure 6-9 Snippet Library

ii) Add a snippet to the current Schedule File.

(1) If the Schedule File doesn't already have Steps, click and drag the snippet you want to use from the Snippet Library to the blank space in the Schedule File Editor.

(2) If the Schedule File already has Steps, click and drag the snippet you want to use from the Snippet Library to the upper or lower edge of the current Steps.

NOTE: The Snippet Library is currently only supported in Grid Mode and cannot be used in Simple Gride Mode.

Import/Add/Insert Step/Limit

9) **Import Step** – Import a Step from another Schedule File.

a) Click on the "Import Step" icon in the Schedule file toolbar to open the Import Step Interface.

b) Navigate to and select the Schedule File where the step is to be imported.

c) Click the "Open" button.

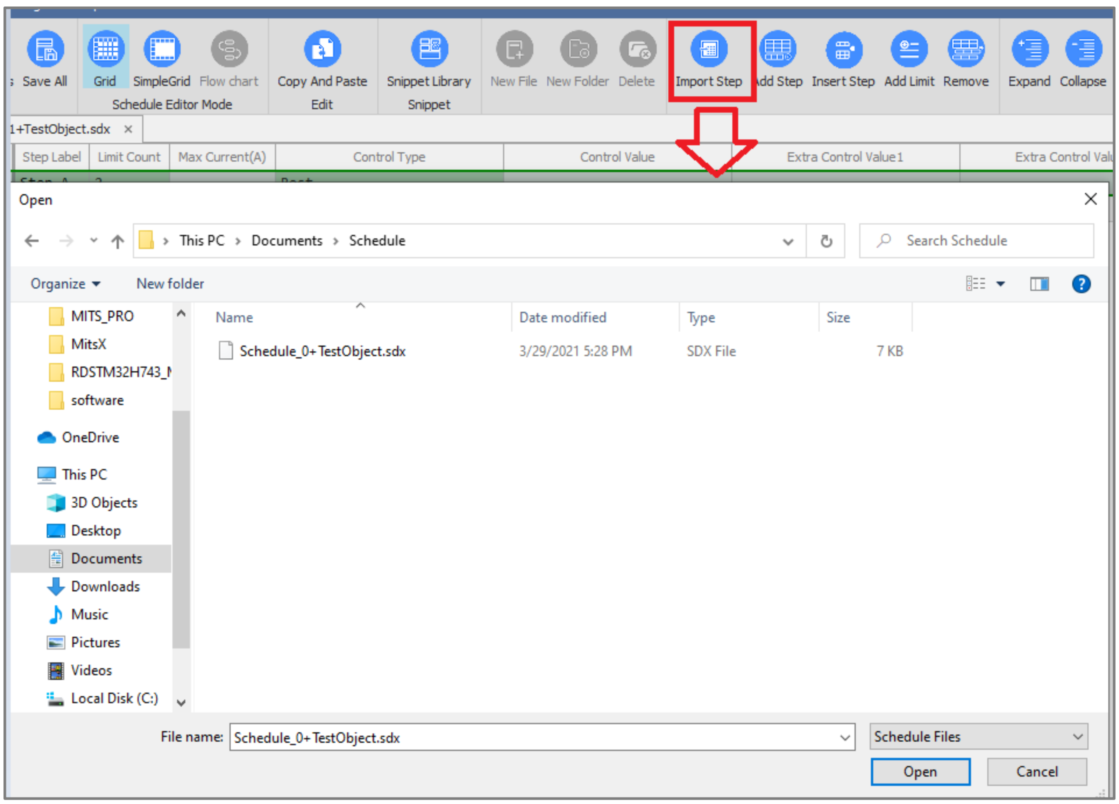


Figure 6-10 Import Step

    d) Select the Step or Steps to import to the selected Schedule File.
    e) Click the "OK" button to import the selected Step or Steps.

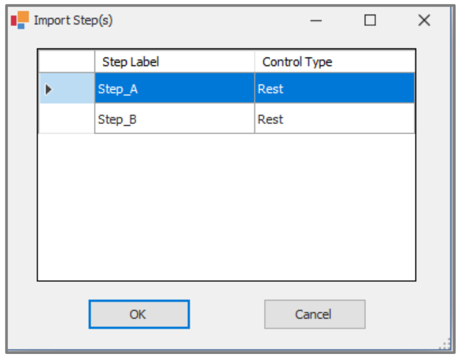


Figure 6-11 Import Step(s) Interface

10) **Add Step** –Add a Step to the current Schedule File.
    a) Select a Step in the current Schedule File and add a Step in one of two ways:
    b) Click on the "Add Step" icon in the Schedule File Toolbar.
    c) Right-click on the Step and select the "Add Step" option on the menu that appears.
    d) A new Step will be added after the currently selected Step
11) **Insert Step** – Insert a Step into the current Schedule File.
    a) Select a Step in the current Schedule File.
    b) Click on the "Insert Step" icon in the Schedule File Toolbar to add a new Step before the currently selected Step.
12) **Add a Limit** –Add a Step Limit or Log Limit to the current Schedule File.
    a) Select a Limit in the current Schedule File.
    b) Click on the "Add Limit" icon in the Schedule File Toolbar.
    c) To add a Limit after the currently selected limit, choose the type of Limit to add.
        i) Select Step Limit to add a new Step Limit.
        ii) Select Log Limit to add a new Log Limit.
    d) You can also add a Limit by right-clicking on an existing Step and clicking on either "Add Step Limit" or "Add Log Limit" in the menu that appears.

NOTE: The maximum number of Step Limits and Log Limits is 45.

Remove Step/Limit

13) **Remove** – Delete a Step or Limit or multiple Steps.
    a) Select a Step, Steps, or a Limit in the current Schedule File.
    b) Click on the "Remove" icon in the Schedule File Toolbar to delete the currently selected Step, Steps, or Limit.

Expand/Collapse

14) **Expand** – Click on the "Expand" icon in the Schedule File Toolbar to expand all Steps in a single click and display the Schedule in Detailed View.

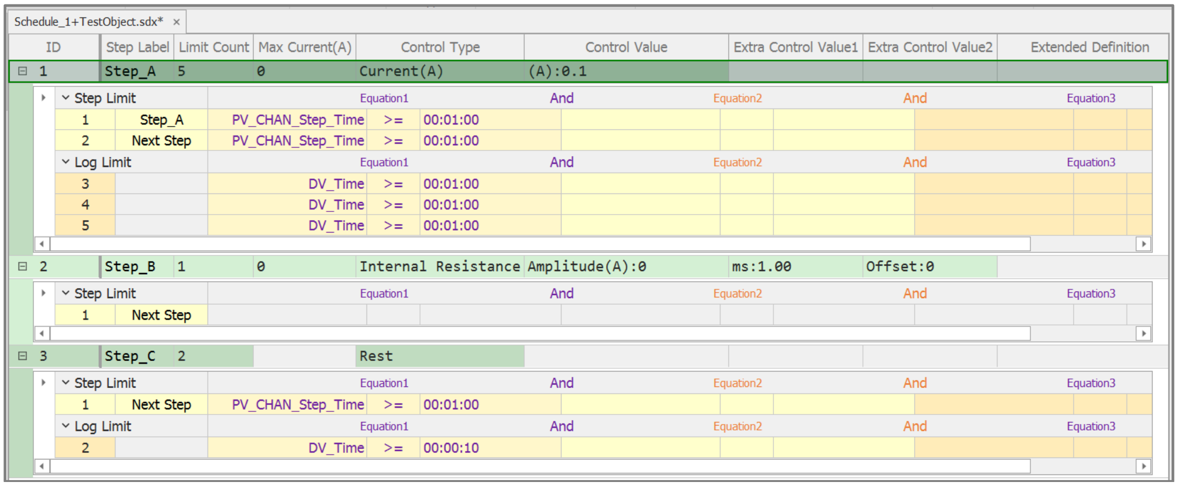


Figure 6-12 Expanded to Detail View

15) **Collapse** – Click on the "Collapse" icon in the Schedule File Toolbar to collapse all Steps and display only Step controls.

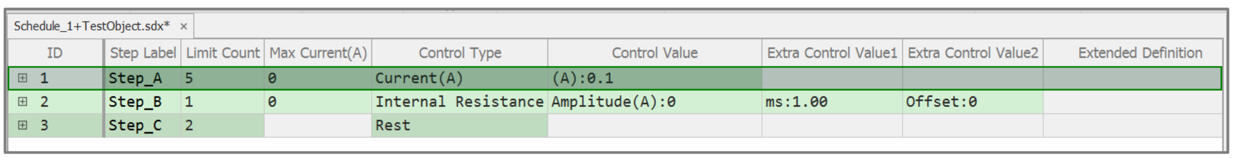


Figure 6-12 Collapsed View

NOTE: The Expand/Collapse feature only works in Grid Mode.

Options

16) **Options** – Manage Schedule Editor Options.
    a) The Options function is divided into two versions: the local version, which can set the Schedule Working Directory, and the remote version, which cannot set the Schedule Working Directory.
    b) Open the Options Interface:
        i) Using the Local Version:
            (1) In Mits X, Right-click on the Schedule Editor icon.
            (2) Click on the "Open This App Locally" option that appears to open the Options Interface.

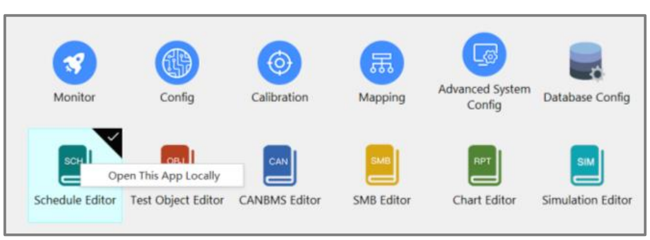


Figure 6-13 Open the Schedule Editor Locally

ii) Using the Remote Version:

(1) In the Schedule Editor, click on the "Options" icon to open the Options Interface.

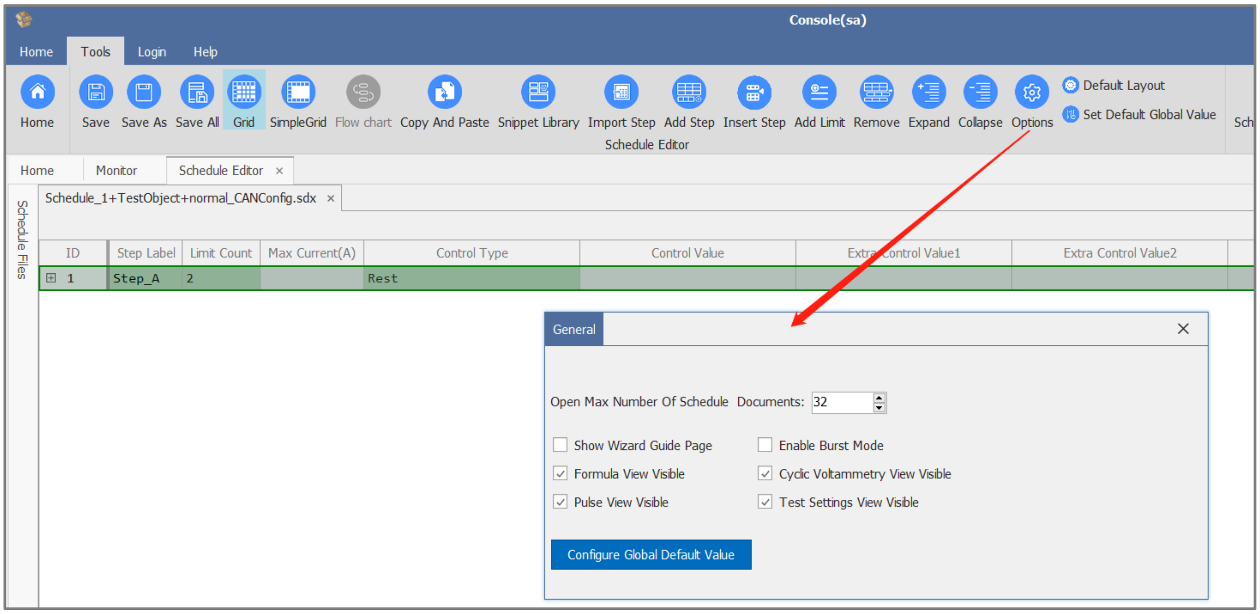


Figure 6-14 Open the Options Interface

c) Manage the Schedule Editor Options.

i) Set the Schedule Working Directory (Local Version only).

(1) Click the three dots on the right of the Working Directory field.

(2) Select the Working Directory for the Schedule.

(3) Click "OK" to set the Schedule Working Directory.

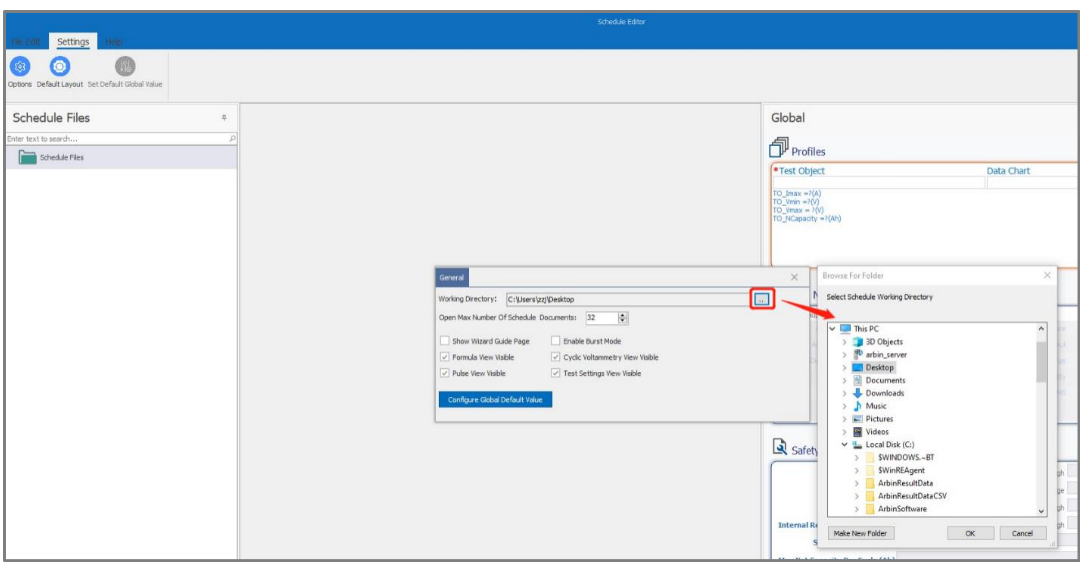


Figure 6-15 Open the Options Interface

17) **Open Max Number of Schedule Documents:** Set the number of Schedule Files that can be open at the same time.
18) **Show Wizard Guide Page:** Display the welcome page of the Schedule Wizard.
19) **Formula, Pulse, Cyclic Voltammetry, Test Settings View Visible:** Choose whether to display these pages on the right side of the Schedule File Editor.

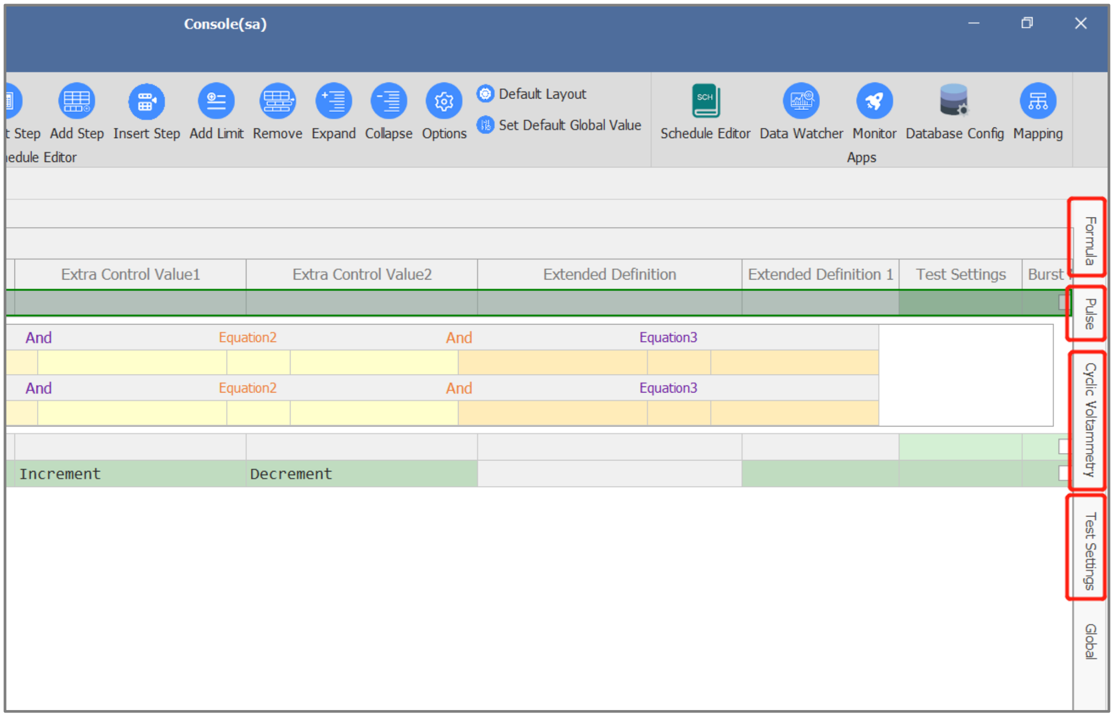


Figure 6-16 Schedule Editor Display with Formula, Pulse, Cyclic Voltammetry, and Test Settings Enabled

20) **Enable Burst Mode:** Display the related table display of Burst Mode.

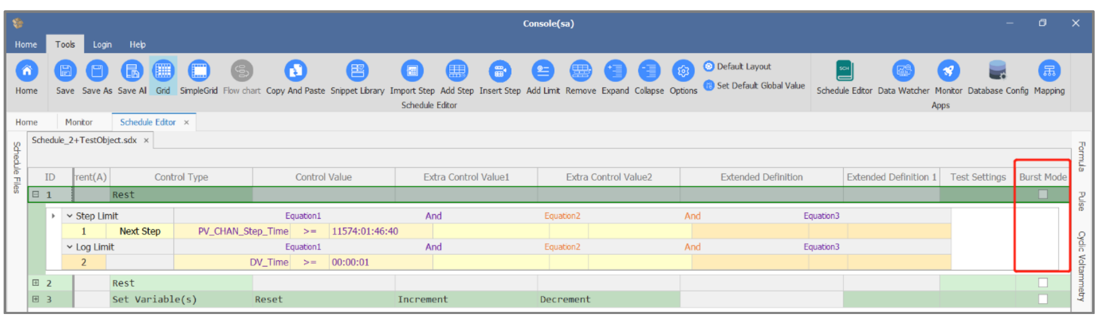


Figure 6-17 Burst Mode Column Added to Schedule Editor

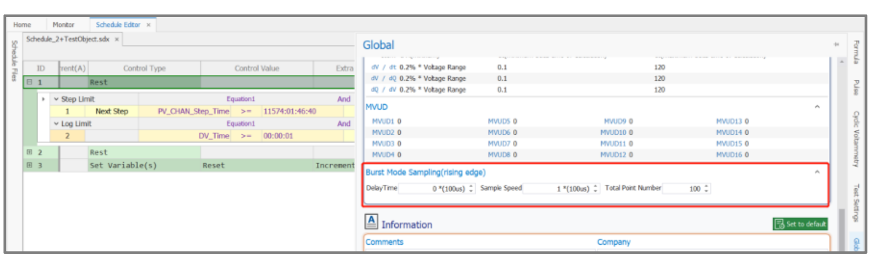


Figure 6-18 Burst Mode Setting on the Global Page

21) **Configure Global Default Value:** Click the "Configure Default Value" button to open the "Configure Global Default Value" Interface.

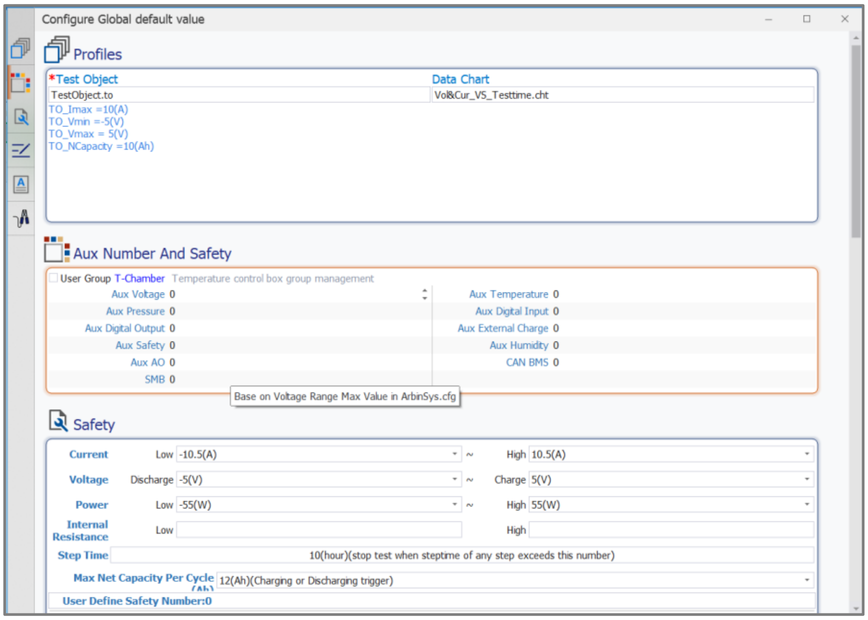


Figure 6-19 Configure Global Default Value Interface

Default Layout/Set Default Global Value

22) **Default Layout:** Click on the "Default Layout" icon in the Schedule Editor Toolbar to restore the default layout.
23) **Set the Default Global Value:** Set the Global Value of the current Schedule File to the default value configured in the "Configure Global Default Value" Interface.
24) Click on the "Set the Default Global Value" icon in the Schedule Editor Toolbar.
25) In the "Set Default Global Value" Interface that appears, click on the "Set to Default" button to set the Default Global Value.

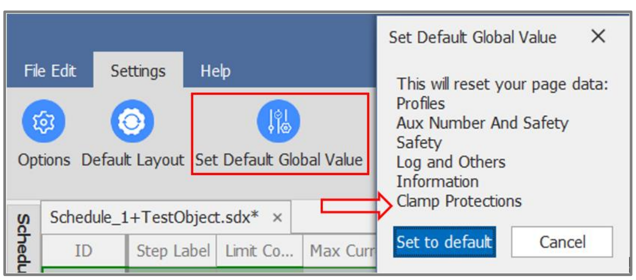


Figure 6-20 Set Default Global Value

6.2 Manage Schedule Files

6.2.1 Open the Schedule File Directory

1) Open the Schedule Editor.
2) Click the “Schedule Files” button on the left side of the Schedule Editor to show the hidden Schedule File Directory and manage Schedule Files.

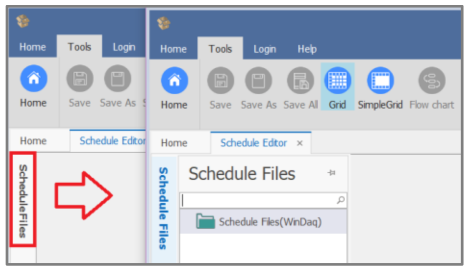


Figure 6-21 Show the Schedule File Directory

6.2.2 Create a New Schedule File

Create the Schedule File

1) Open the Schedule File Directory.
2) Right-click on the Schedule Files in the Directory.
3) Select the “New File” option to open the Schedule Wizard.

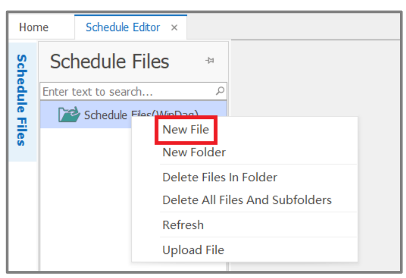


Figure 6-22 Create a New Schedule File

4) If the "Show Wizard Guide Page” is checked in the Schedule Options, the Welcome Page for the Schedule Wizard will appear.

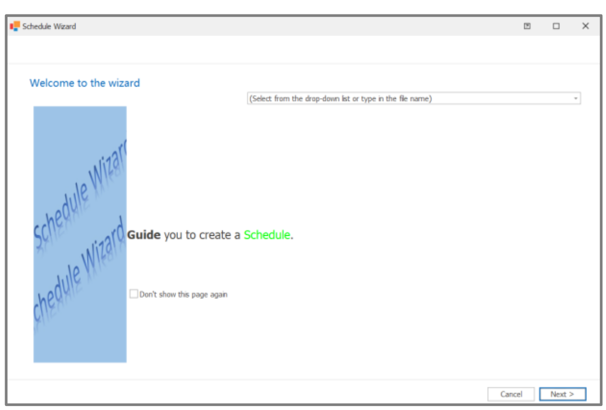


Figure 6-23 The Welcome Page of the Schedule Wizard

Configure the Global Safety Page

1) Set the Global Safety Limits by clicking on the drop-down menu for each value. The values can be entered as actual values, as a percentage, or as an MV_UD variable.
   a) Set the low and high values for current.
   b) Set the low and high values for voltage.
   c) Set the low and high values for power.
   d) Set the high value for capacity.
   e) Set the low and high values for internal resistance.

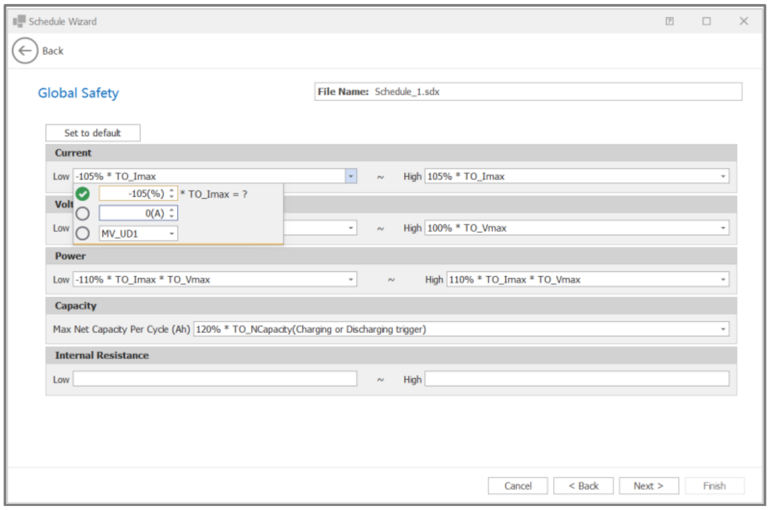


Figure 6-24 Set the Global Safety Limits

2) Click the "Next" button to go to the Default Log page.

Set Additional Configurations (Default Log, Aux Channel Requirement, Items, and Other)

1) Set the Default Log.
   a) Customize the Default Log or set it to be automatically calculated by formula
   b) Click the "Next" button to edit additional Schedule File pages or click "Finish" to complete creating the Schedule File.

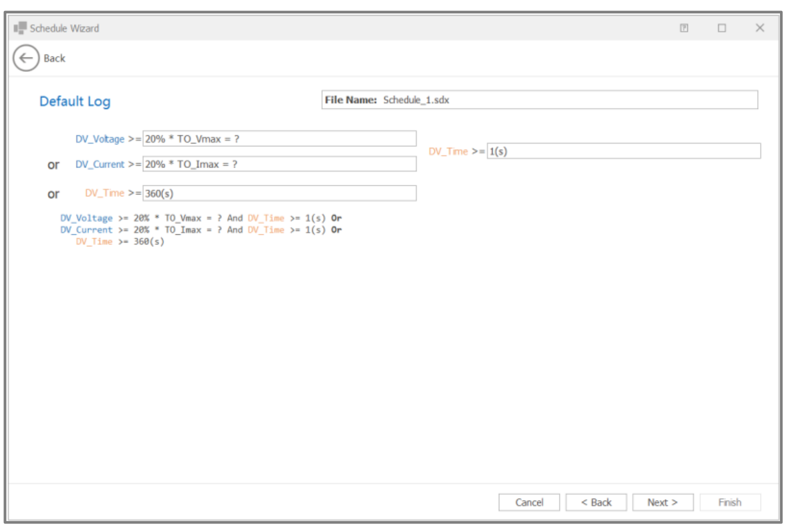


Figure 6-25 Set the Default Log

2) Set the Aux Channel Requirements.
   a) Use this page of the Schedule File if the test involves the use of auxiliary channels including but not limited to temperature, secondary voltage, CAN BMS, and SMB.
   b) For each auxiliary option, enter the number of auxiliary channels that are needed to run the Schedule on a regular IV channel.
   c) The entered numbers are used as a cross-check to ensure that the auxiliary mapping meets the Schedule requirements. The test will not run if the numbers don't match.
   d) Click the "Next" button to edit additional Schedule File pages or click "Finish" to complete creating the Schedule File.

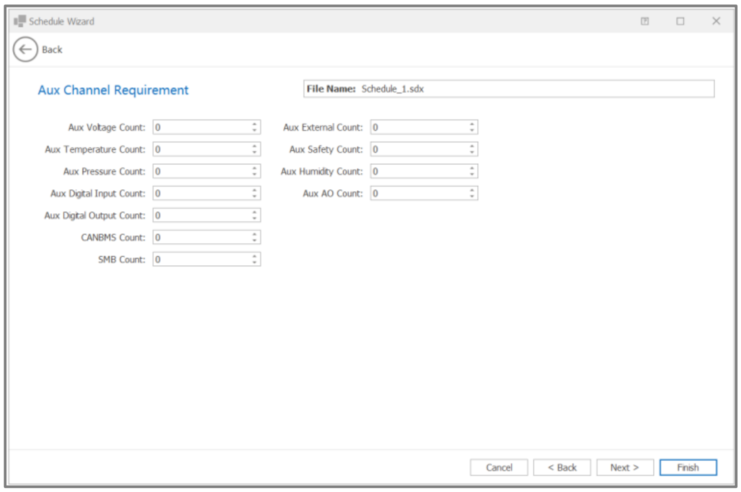


Figure 6-26 Set the Auxiliary Channel Requirements

3) Add Items to the Schedule File.
   a) Use this page of the Schedule File to preset the number of Steps, Formula, Pulse, CV, and Test Settings for the Schedule File wizard.
   b) For Steps, the default number is 2; the default number for the rest is 0. Use the drop-down menu to change the numbers for each item.
   c) Click the "Next" button to edit additional schedule File pages or click "Finish" to complete creating the Schedule File.

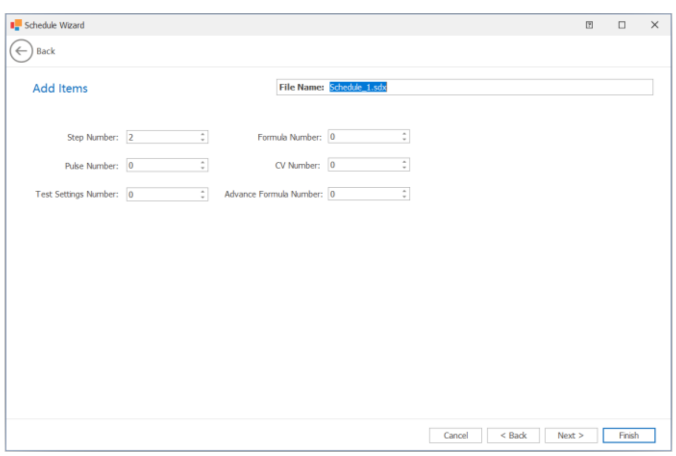


Figure 6-27 Add Items to the Schedule File

4) Complete the Other page.
   a) In the Creator field, enter the name of the Schedule creator or enter the username of the current user account.
   b) In the Company field, enter the user company name or the test subject manufacturer name.
   c) In the Comments field, enter any general comments about this Schedule.

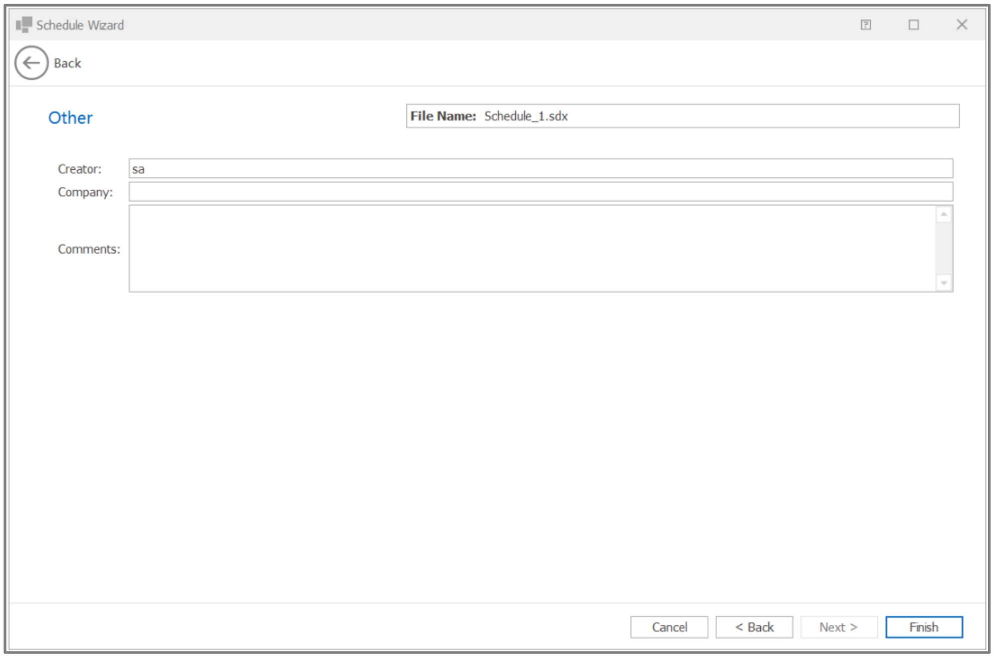


Figure 6-28 Complete the "Other" Page for the Schedule

   d) Click "Finish" at the bottom of the Schedule Wizard to complete creating the Schedule File and view the Schedule File page.

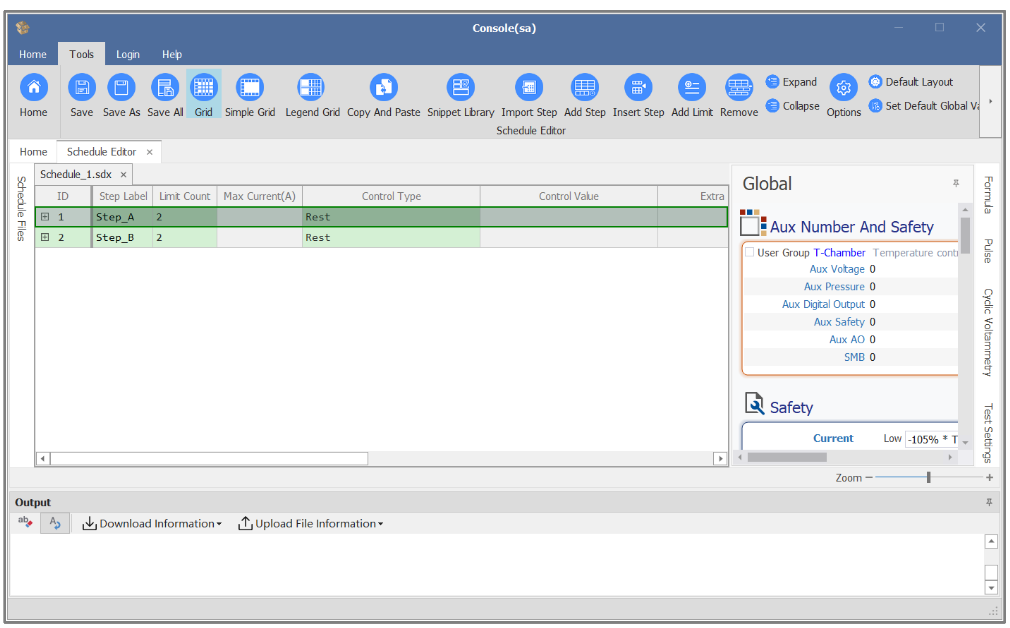


Figure 6-29 The Schedule File Page

6.2.3 Search for a Schedule File by Name

1) Open the Schedule File Directory.
2) Click in the search box above the Schedule File list and type the text of your search.
3) Schedule Files with names matching the search text will display below the search box.

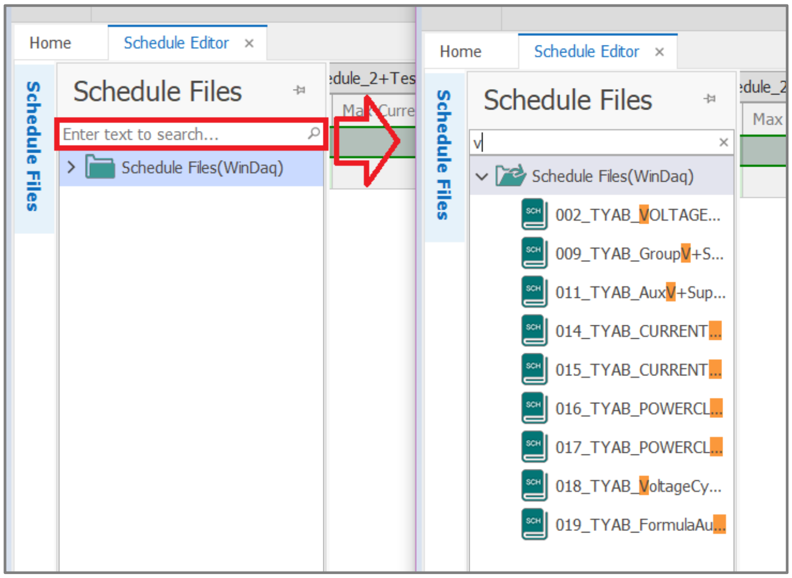


Figure 6-30 Search for a Schedule File by Name

6.2.4 Open a Schedule File

1) Open the Schedule File Directory.
2) In the Directory, right-click on the Schedule Files you want to open.
3) Select the “Open” option to open the Schedule File.

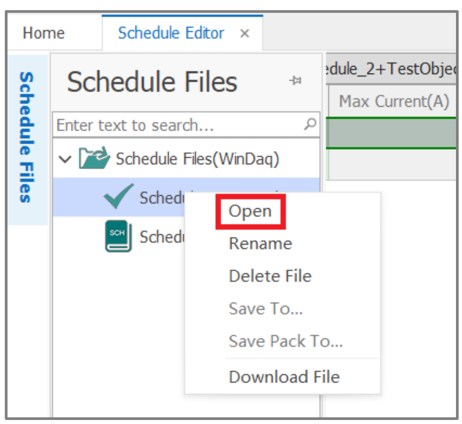


Figure 6-31 Open a Schedule File

6.2.5 Upload a Schedule File

1) Open the Schedule File Directory.
2) In the Directory, right-click on the list of Schedule Files.
3) Select the “Upload File” option.
4) In the “Select Files” pop-up Interface, select the Schedule File you want to upload.
5) Click the “Open” button to upload the Schedule File.

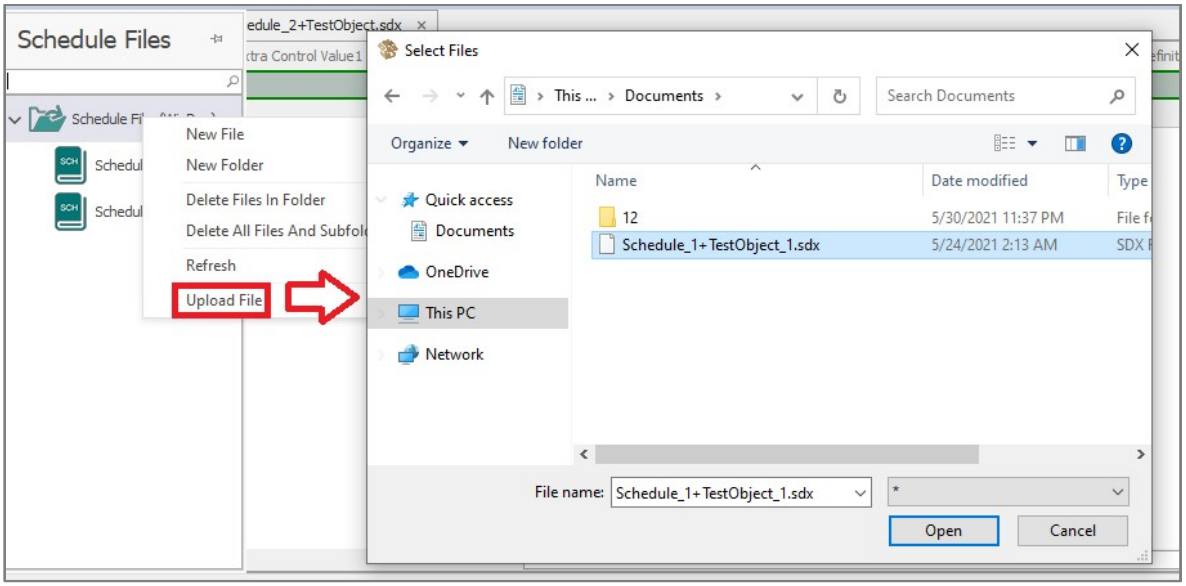


Figure 6-32 Upload a Schedule File

6.2.6 Rename a Schedule File

1) Open the Schedule File Directory.
2) In the Directory, right-click on the Schedule File you want to rename.
3) Click on the “Rename” option in the menu that appears to open the “Rename” Interface.
4) In the “Rename” pop-up Interface, enter the new file name in the Name input box.
5) Click the “OK” button in the pop-up Interface that appears to confirm the renaming of the Schedule File.

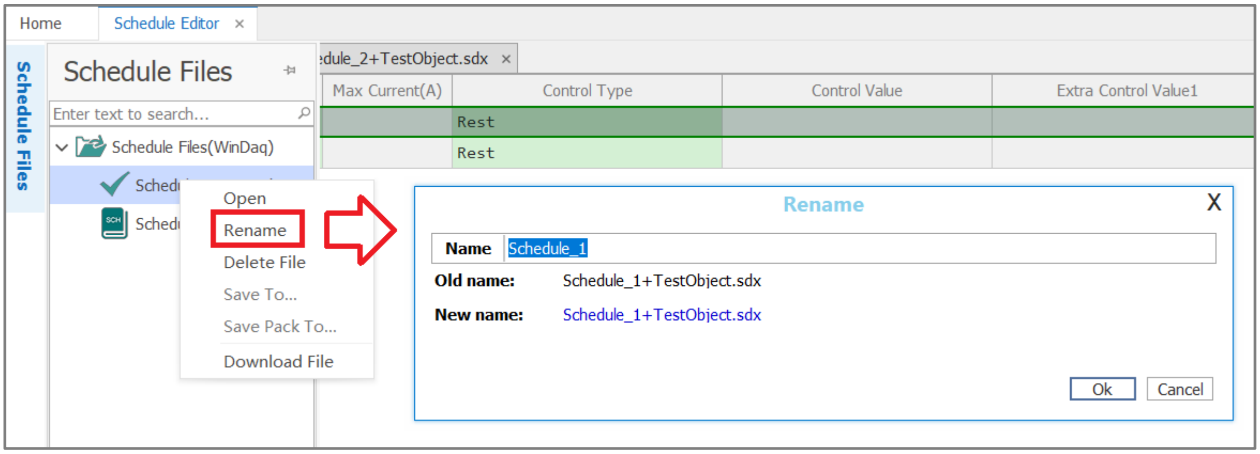


Figure 6-33 Rename a Schedule File

6.2.7 Download a Schedule File

1) Open the Schedule File Directory.
2) In the Directory, right-click on the Schedule File you want to download.
3) Click on the "Download File" option in the menu that appears to open the "Save As" Interface.
4) In the "Save As" pop-up Interface, select the location where you want the file to be saved.
5) Click the "Save" button to download the Schedule File.

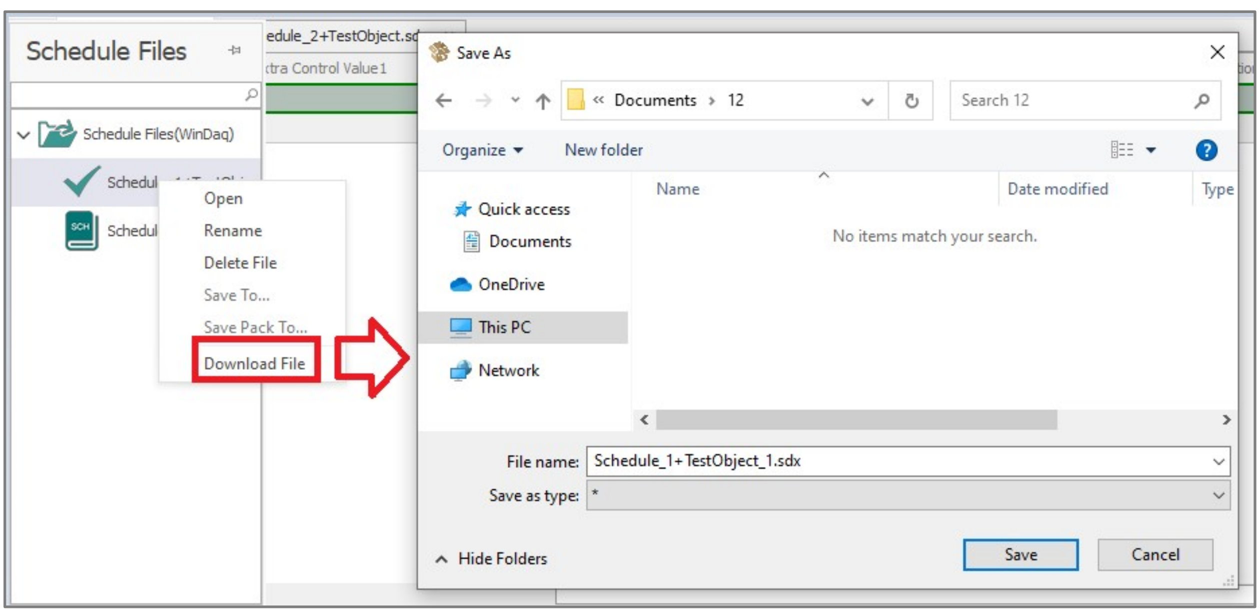


Figure 6-34 Download a Schedule File

6.2.8 Save a Schedule File to a Different Location

This feature is temporarily not supported.

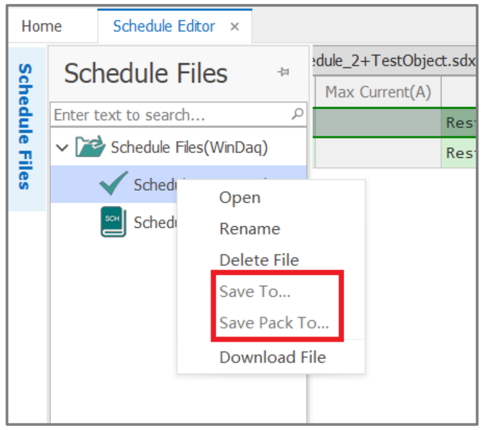


Figure 6-35 Save To and Save Pack To Options are Currently Not Supported

6.2.9 Delete a Schedule File

1) Open the Schedule File Directory.
2) Right-click on the Schedule File you want to delete in the Directory.
3) Click on the "Delete File" option. In the menu that appears.
4) Click the "OK" button in the pop-up Interface that appears to confirm deletion of the selected file.

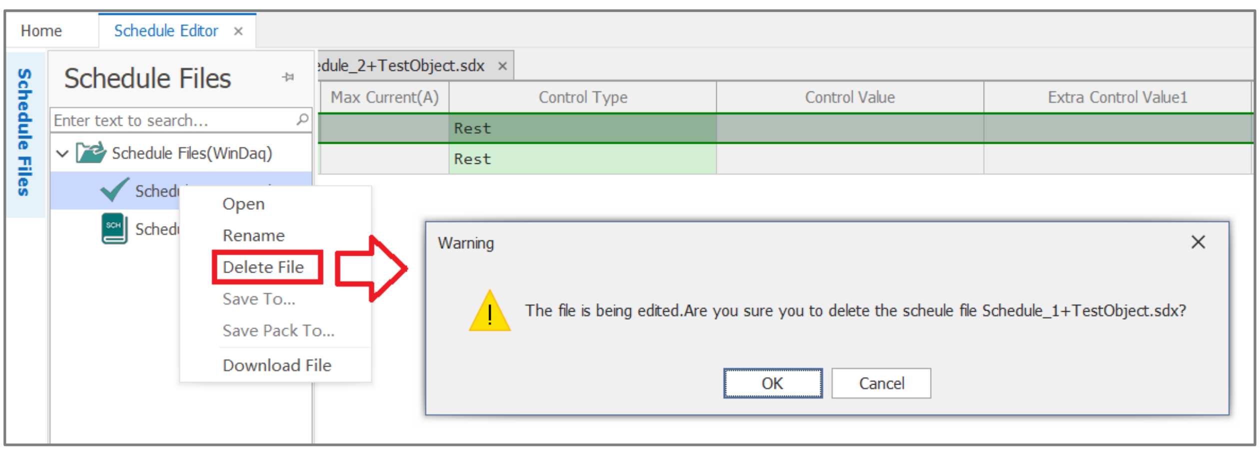


Figure 6-36 Delete the Selected Schedule File

6.3 Manage the Schedule File Directory

6.3.1 Create a New Schedule File Folder

1) Open the Schedule File Directory.
2) In the Directory, right-click on the list of Schedule Files
3) Click on the “New Folder” option in the menu that appears.
4) A new folder will be added to the Schedule File Directory.

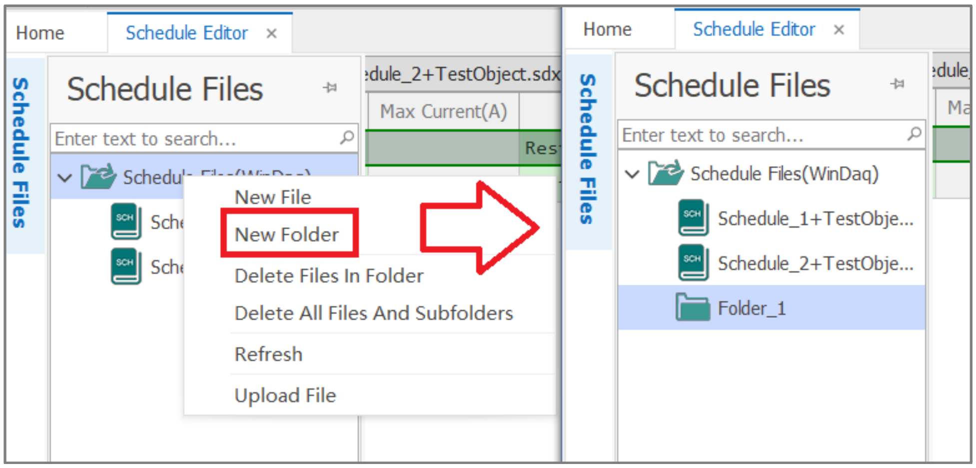


Figure 6-37 Create a New Schedule File Folder

6.3.2 Rename a Schedule File Folder

1) Open the Schedule File Directory.
2) In the Directory, right-click on the Schedule File Folder you want to rename.
3) Click on the “Rename” option in the menu that appears to open the “Rename Folder” Interface.
4) In the “Rename Folder” Interface, enter the new file name in the Name input box.
5) Click the “OK” button in the “Rename Folder” Interface to confirm the renaming of the selected Schedule File Folder.

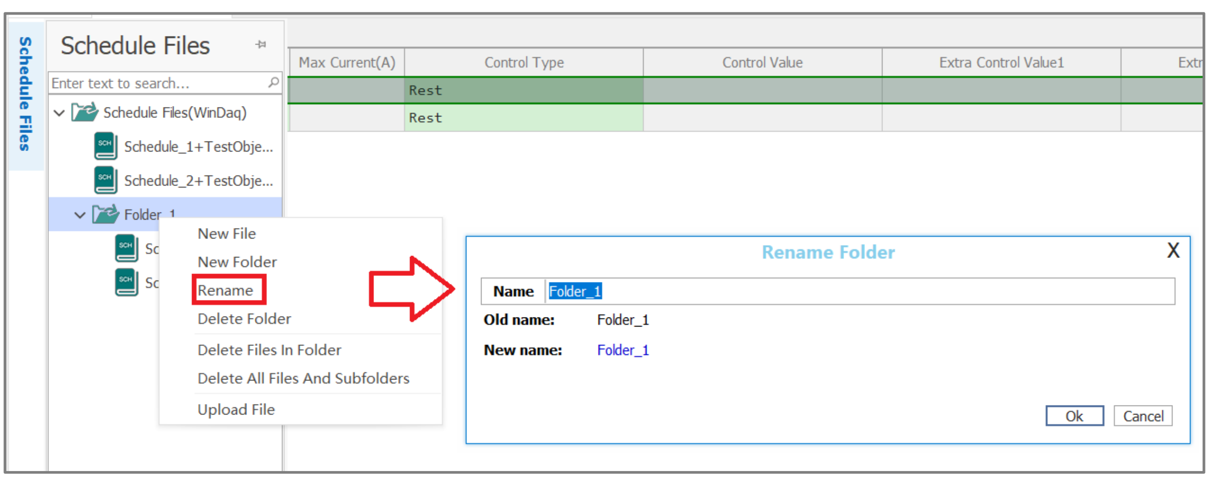


Figure 6-38 Rename a Schedule File Folder

6.3.3 Refresh the Schedule File Directory

1) Open the Schedule File Directory.
2) Right-click on the Schedule Files in the Directory.
3) Click on the "Refresh" option in the menu that appears to refresh the Schedule File Directory.

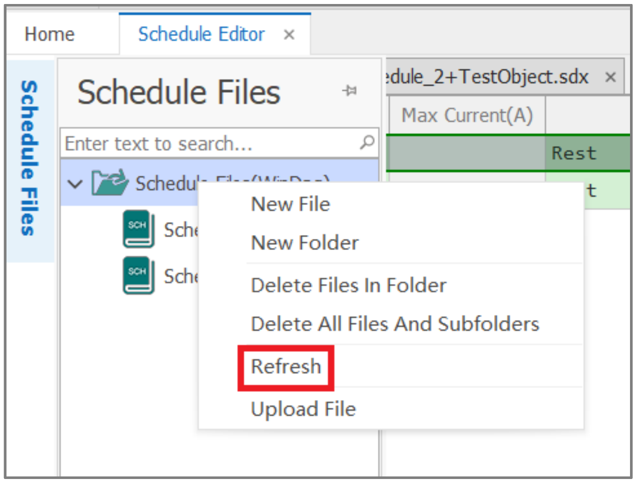


Figure 6-39 Refresh the Schedule File Directory

6.3.4 Delete a Schedule File Folder

1) Open the Schedule File Directory.
2) Right-click on the Schedule File Folder you want to delete in the Directory.
3) Click on the "Delete Folder" option in the menu that appears.
4) Click the "OK" button in the pop-up Interface that appears to confirm deletion of the selected Schedule File Folder and the Schedule Files and subfolders inside that folder.

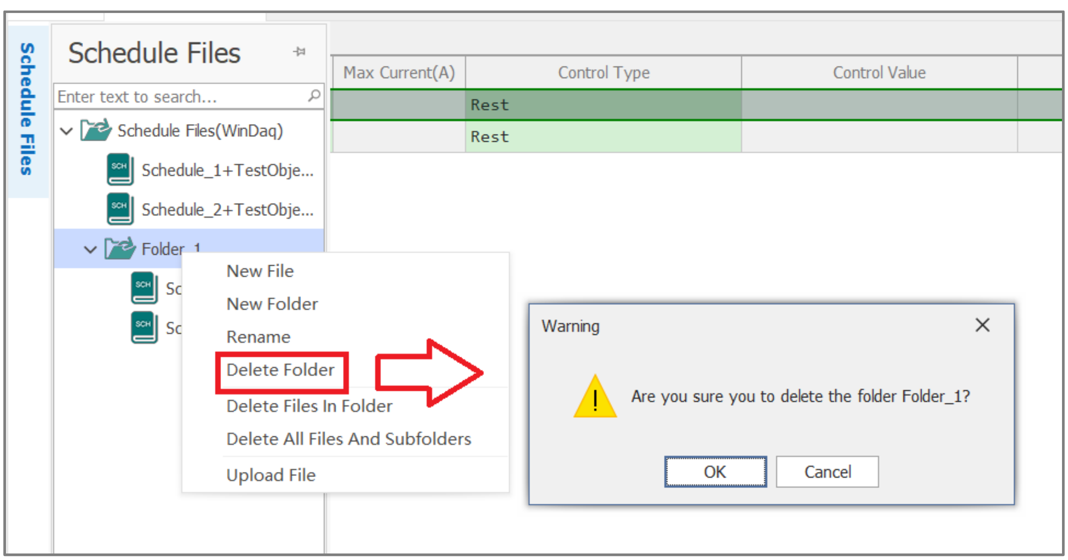


Figure 6-40 Delete a Schedule File Folder

6.3.5 Delete All Schedule Files in a Folder

1) Open the Schedule File Directory.
2) Right-click on the Schedule File Folder you want to delete in the Directory.
3) Click on the "Delete All Files in Folder" option in the menu that appears.
4) Click the "OK" button in the pop-up Interface that appears to confirm deletion of the Schedule Files in the selected Schedule File Folder.

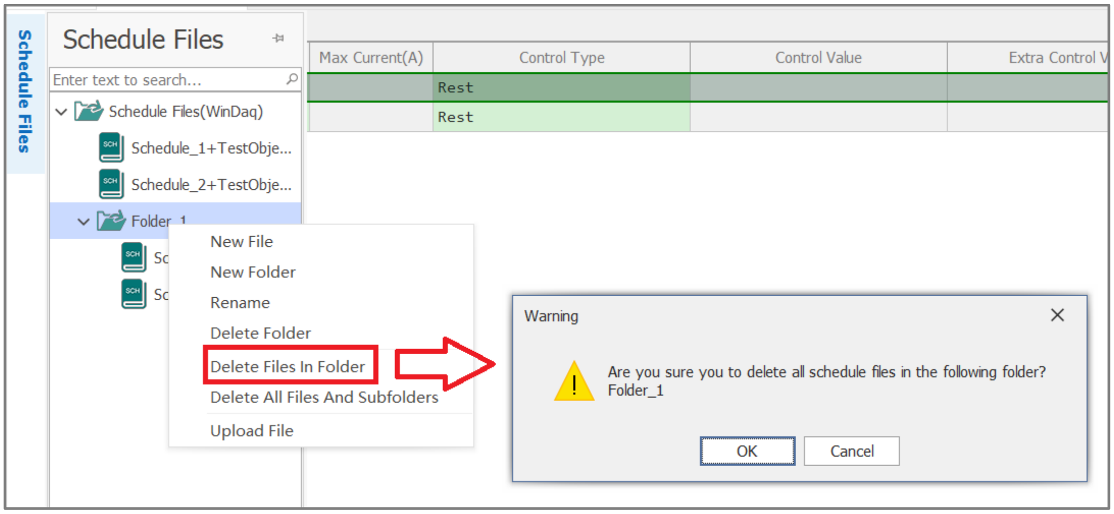


Figure 6-41 Delete All Schedule Files in a Folder

6.3.6 Delete All Schedule Files and Subfolders in a Folder

1) Open the Schedule File Directory.
2) Right-click on the Schedule File Folder you want to delete in the Directory.
3) Click on the "Delete All Files and Subfolders" option in the menu that appears.
4) Click the "OK" button in the pop-up Interface that appears to confirm deletion of the Schedule Files and subfolders in the selected Schedule File Folder.

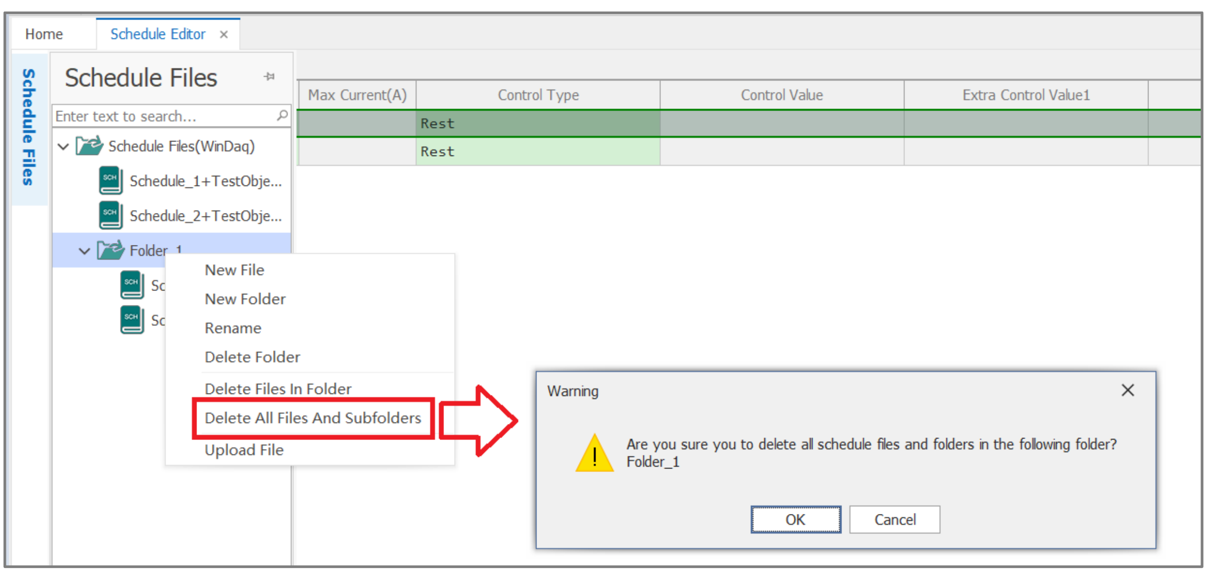


Figure 6-42 Delete All Schedule Files and Subfolders in a Folder

6.4 Configure Settings for the Global Page

6.4.1 Set the Auxiliary Channel Values

The Aux Number and Safety section is used to set any auxiliary channels that your test may involve, including temperature, secondary voltage, CAN BMS, and SMB. The count value indicates the number of auxiliary channels needed to run the Schedule on a regular IV channel. The Aux Number and Safety section is used to cross-check whether the auxiliary mapping meets the test requirements.

1) Fill in the auxiliary channel quantity in one of two ways:
   a) Click the input box for each channel type to enter the quantity directly.
   b) Right-click on the icon to the right side of the input box to adjust the quantity.
2) Fill in the corresponding safety value range for each channel.
   a) Red letters will appear to show where a safety value range needs to be added.

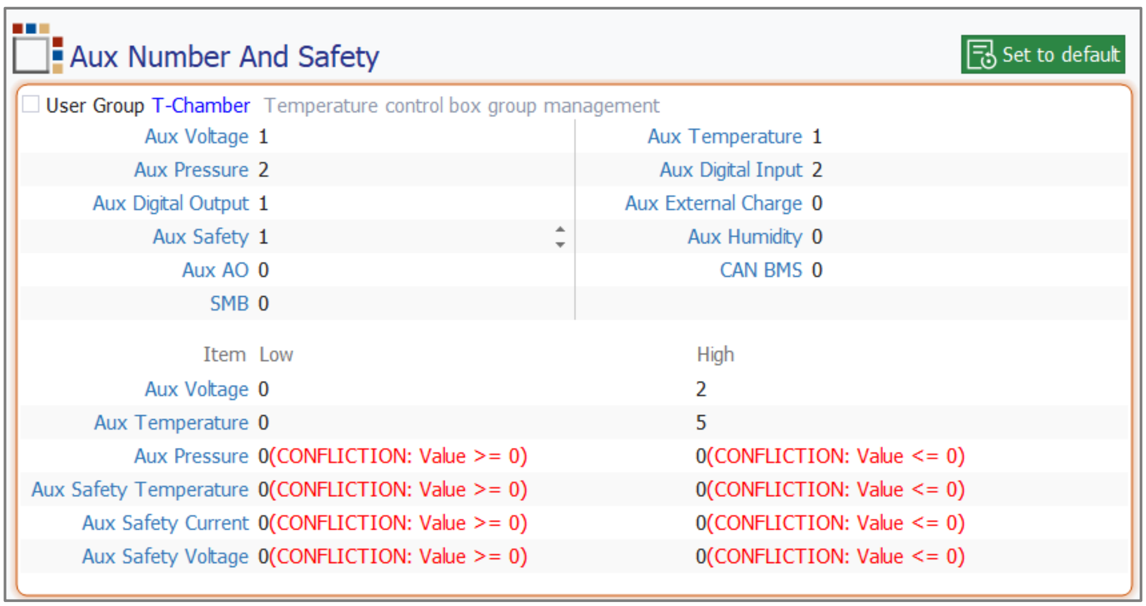


Figure 6-43 Set the Auxiliary Channel Values

6.4.2 Set the Safety Limit Parameters

The Safety section of the Global Page is used to set the high and low values of the current, voltage, and power limits, the high value of the capacity, and the maximum time for a single step of the Schedule to run on the regular channel. The user can also input other safety limit parameters, including auxiliary voltage, temperature, pressure, pH, and safety.

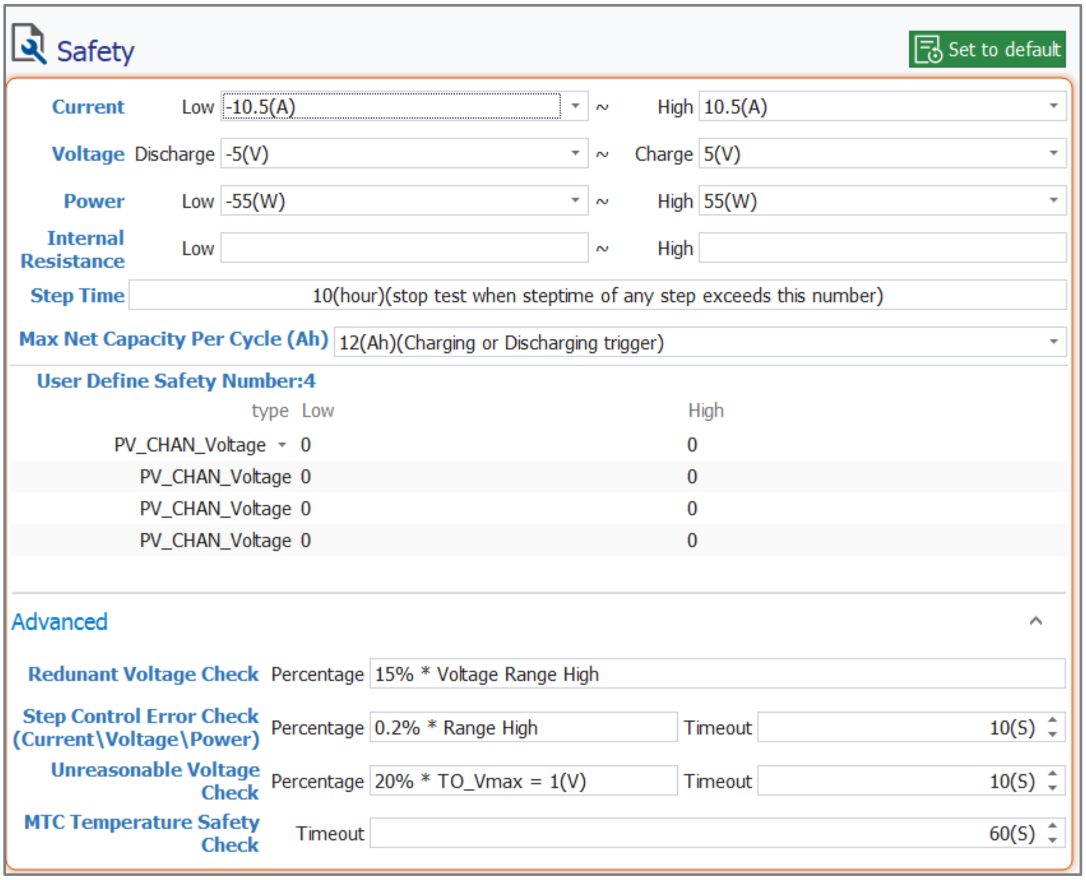


Figure 6-44 Safety Section of the Global Page

NOTE: The user should be aware of the voltage and current limits of the battery test equipment and not exceed these limits.

If any parameter exceeds the safety limit set in the running Schedule, the battery tester will terminate the test to protect the test equipment and the device under test. The Monitor and Control Interface will also display the Unsafe situation.

Enter the Voltage Safety Limit

1) Enter the low and high safety limits of the regular channel (main IV channel) voltage for the Test Schedule.
2) The voltage safety limit may be a numeric value such as 2V, or a value relative to the Vmax/Vmin of the Test Object File such as 80%. If the value is related to Vmax/Vmin, enter a percentage between -100 and 100 for the voltage safety limit.

Enter the Current Safety Limit

1) Enter the low and high safety limits of the regular channel (main IV channel) current for the Test Schedule.
2) The current safety limit may be a numeric value, or a value relative to the Test Object File Imax. If the value is related to Imax enter a percentage between -105 and 105 for the current safety limit.

EXAMPLE: If the Test Object Imax of the Schedule is 3A and the low current safety limit is -105%* Imax, the minimum current limit is -3.15 A. If the Test Object has an Imax of 5 A, the high current safety limit is 105% Imax, the maximum current limit will be 5.25 A. The voltage safety limit setting is set the same way as the current safety limit setting.

Enter the Power Safety Limit

1) Enter the low and high safety limits of the regular channel (main IV channel) power for the Test Schedule.
2) The current safety limit may be a numeric value, or a value relative to the Test Object File Imax or Vmax/Vmin. If the value is related to the Test Object Imax or Vmax/Vmin, enter a percentage between -110 and 110 to limit the power safety limits of the instrument.

Enter the Capacity Safety Limit

1) Enter the capacity safety limit of the regular channel (main IV channel) for the Test Schedule.
2) The capacity safety limit must be a numeric value. If the values are related to the rated capacity of the Test Object, enter a percentage between -120 and 120 to limit the current safety limit the current safety limits of the instrument.

Enter the StepTime Safety Limit

1) Enter the step time safety limit of the regular channel (main IV channel) for the Test Schedule).
2) The step time safety limit must be a numeric value. The default step time safety limit for a new Schedule is 10 hours, but this can be changed to any positive number.
3) The step time safety limit is designed to prevent unexpected and unnoticeable overcharging or discharging.

Enter the Aux Safety Limits

The auxiliary channel refers to the auxiliary input that is mapped to the main IV control channel. Although the auxiliary channels and their parameters cannot be controlled, their inputs can be used to control the operation of the main IV channels. The type of input provided by the auxiliary channels depends on the relevant hardware and system configuration.

1) Enter the low and high safety limits for the auxiliary voltage, temperature, pressure, pH, and flow (Flow) measurement channels.

Enter the User Define Safety Number

1) Enter a number in this label to generate input boxes for additional user-defined safety limits.
2) Supported meta variables include current value, last step value, last period value, CAN BMS, value, and more.

Advanced Safety
Advanced Safety detection stops the Schedule or issues a warning during the test if an abnormal or unreasonable event occurs (such as a sudden drop in voltage or disconnection of the IV channel cable). When an anomaly occurs, the test may generate bad data or, in the worst case, the battery will be overcharged or depleted. Advanced Safety prevents this from occurring. The Advanced Safety settings include Redundant Voltage Check, Step Control Error Check, and Unreasonable Voltage Check.

Unreasonable Behavior Check
The software monitors the voltage, current, power, and MTC temperature during the Test. When the output exceeds the percentage of a given value for a given Timeout(s) period, the system will trigger a warning and stop the test.

These values are found under the “Advanced” heading of the Safety Interface. The default value of the percentage is 20% which is related to Vmax and the default timeout is 10 seconds. The range of percentage is from 0 to 100.

By default, the following conditions are considered an anomaly:

1) Redundant voltage is greater than 115% of the rated value.
2) Voltage/current/power exceeds 120% of the setting value for 10 seconds.
3) Single step time is greater than 4 hours.
4) The current voltage is lower than 80% of the rated voltage for 10 seconds.
5) The capacity remains unchanged, and the temperature rises.

6.4.3 Set Log and Other Global Page Factors

Default Log Limit
The Default Log Limit is used when no specific log limit is assigned to a particular Step. Here, the Log Limit is the Global Log Limit of the Schedule, and data logging is triggered in every Step that this condition is reached.

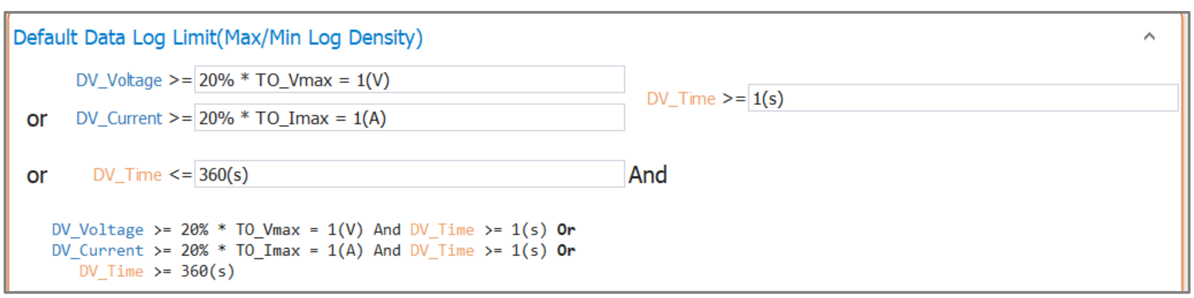


Figure 6-45 Set the Default Log Limit

Power Adjustment

The Power Adjustment setting is used to support Power Adjustment for resistance loadings.

1) Click to check the checkmark box for “Use Resistor Load.”
2) Click in the input field to input the resistor value for the Power Adjustment feature.

Figure 6-46 Set the Power Adjustment

Estimated Test Time

When the user is running a test, a column named “Remaining Time” is displayed in the Monitor and Control Interface. The remaining time is the estimated time minus the testing time that has already passed.

1) Use hours as the unit to set the estimated test time.

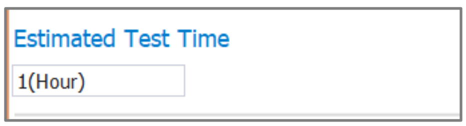


Figure 6-47 Estimated Test Time Setting

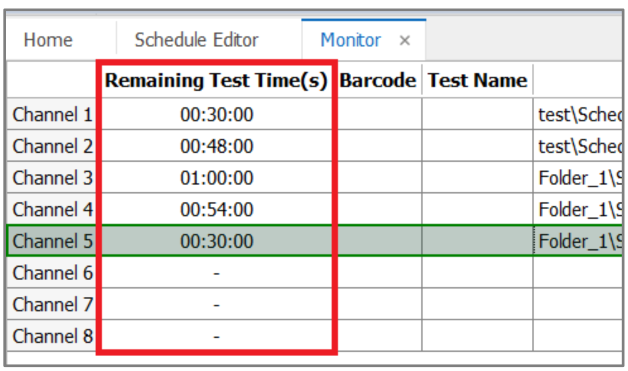


Figure 6-48 Remaining Time Column in the Monitor and Control Interface

dX/dY

This Global Page setting is used to calculate the difference time interval, such as dV/dt and dV/dQ. A minimum calculation interval is required to perform numerical difference calculations. This interval must be greater than the accuracy of the measurement, otherwise, the result is meaningless due to the influence of signal noise.

The appropriate time interval value for dV/dt, dI/dt, DT/dt, etc. is 15 seconds. If the maximum calculation interval is reached, the calculation will be performed no matter what dX is.

1) dV/dt – Voltage changes over time
2) dQ/dV – The voltage change causes the charge of the battery or capacity to change.

dX/dY

Item	d X(mininum)	dt(minimum delta time of Calculation)	dt(maximum delta time of Calculation)
dV / dt	0.2% * Voltage Range	0.1	120
dV / dQ	0.2% * Voltage Range	0.1	120
dQ / dV	0.2% * Voltage Range	0.1	120

Figure 6-49 dX/dY Settings

User-Defined Meta Variables

The User-Defined Meta Variables part of the Global Page allows the user to define additional meta variables that can control the test. On the Global Page, the user can only assign a number to these variables; on the Step/Limit Page, the user can assign Present Values, Last Step Values, Last Cycle Values, and more through the SetValue control type.

MVUD

MVUD1	0	MVUD2	0	MVUD3	0	MVUD4	0
MVUD5	0	MVUD6	0	MVUD7	0	MVUD8	0
MVUD9	0	MVUD10	0	MVUD11	0	MVUD12	0
MVUD13	0	MVUD14	0	MVUD15	0	MVUD16	0

Figure 6-50 User-Defined Meta Variables on the Global Page

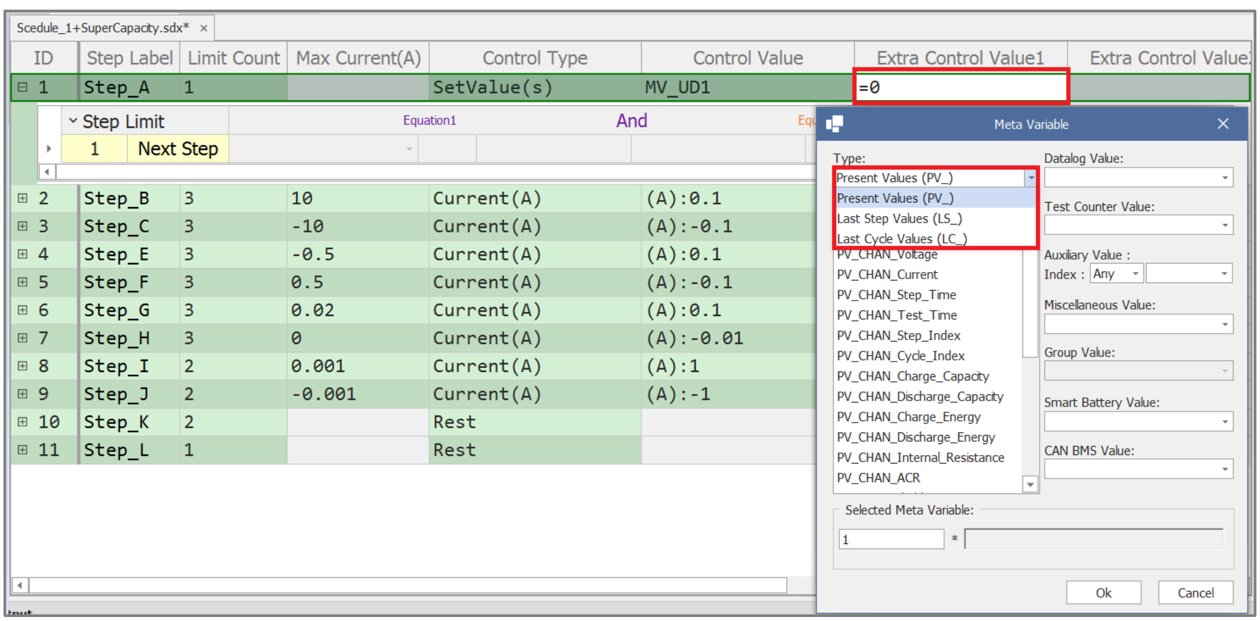


Figure 6-51 User-Defined Meta Variables on the Step/Limit Page

Burst Mode Sampling

Burst Mode Sampling records a large amount of data in a short time interview to display current and voltage changes with high time resolution.

1) Delay Time – The delay time from the start of the step to the start of recording the Burst Mode Sampling data.
2) Sample Speed – The recording interval of the Burst Mode Sampling Data.
3) Total Point Number – When the Total Point Number is met, the Burst Mode Sampling will stop.

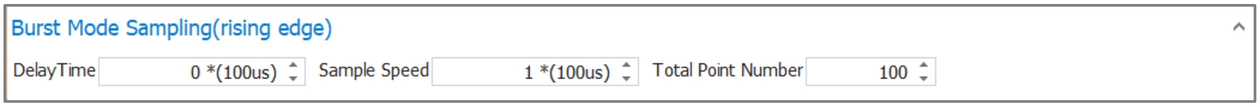


Figure 6-52 Burst Mode Sampling

6.4.4 Edit Schedule File Information

The information that was completed when creating the Schedule File can be edited in the Information section of the Global Page.

1) In the Comments field, enter any general comments about this Schedule.
2) In the Company field, enter the user company name or the test subject manufacturer name.
3) In the Creator field, enter the name of the Schedule creator or enter the username of the current user account.

Figure 6-53 Schedule File Information

6.4.5 Edit Clamp Protection

The Clamp Protection section of the Global Page is used to clamp the voltage or power at a constant value. By default, the clamp protection values are empty, which means that clamp protections are not activated. Arbin Instruments strongly recommends using clamp protections whenever possible to prevent overcharging or discharging.

1) Low Current Clamp/High Current Clamp – The current value does not exceed or go below the set values during battery charging and discharging.
2) Low Voltage Clamp/High Current Clamp – If the battery is charged or discharged to the target voltage value, the current output will decay.
3) Voltage clamping requires special hardware, and not all systems have voltage clamping protections.
4) Low Power Clamp/High Power Clamp – The battery is charged or discharged within these power limits.
5) Low Simulation Voltage Clamp/High Simulation Voltage Clamp – If this clamp is enabled, the Test Schedule must set the IR value or perform an IR step first
6) Only relevant Step types such as current simulation, power simulation, and load simulation are supported for Simulation Clamp Protections.

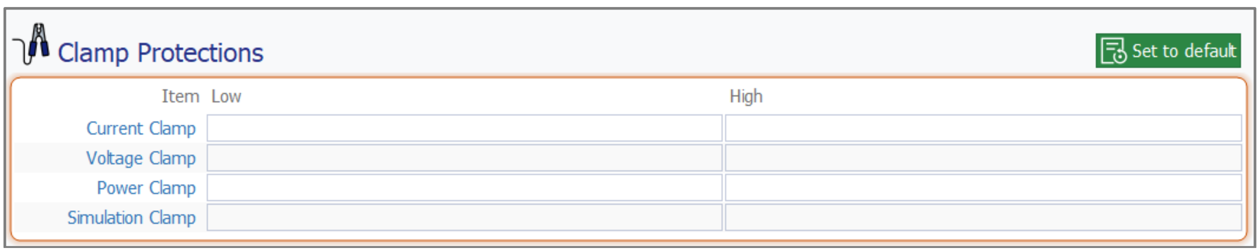


Figure 6-54 Set the Clamp Protections

6.5 Create and Edit Steps and Limits

6.5.1 Introduction to Steps and Limits

What are Steps?

The Step/Limit Page of the Schedule File defines Steps and their corresponding Limits. Schedules may contain 1 to up to 300 steps, with up to 45 Limits per Step. Steps can be set to run in a defined sequence, a sequence that repeats for a specified number of iterations, or a combination of the two.

A Step usually consists of four components:

1) Control Type
2) Control Value
3) Termination Condition (Step Limit)
4) Data Logging (Log Limit)

A Step will continue to run until the termination condition defined in the condition line is met. The Step/Limit Page shown in Figure 6-55 contains 3 Steps, each with different Limits. Step A has 5 Limits, 2 Step Limits and 3 Log Limits; Step B has 1 Step Limit; Step C has 2 Limits: 1 Step Limit, 1 Log Limit.

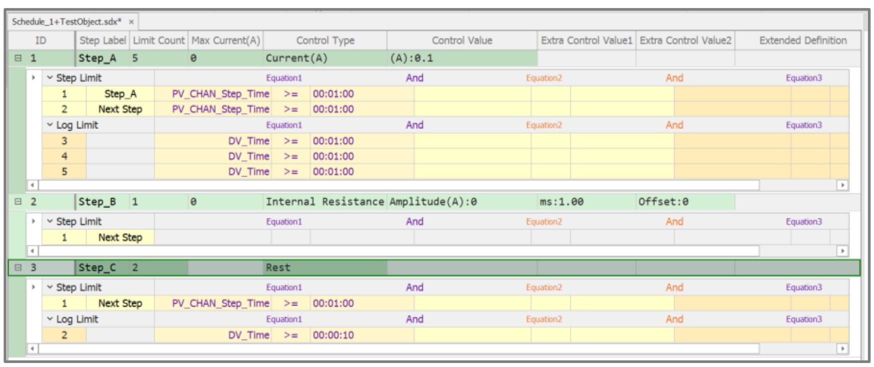


Figure 6-55 Step/Limit Page

What are Limits?

A Limit is a set of conditions that, when met, direct the software to perform certain operations. There are two types of Limits for a Step: the Step Limit, which is used to terminate the active Step, and the Log Limit, which is used to trigger data collection. The parameters used to set Step Limits and Log Limits can be meta variables and formulas. For a detailed description of each meta variable, refer to **Appendix B: Meta Variables**.

Step Limits

A Step can be terminated based on one or multiple Step Limits. You can also specify logical conditions for terminating Steps based on Step Limits. Multiple Limit conditions in a single row form a “logical AND” relationship while multiple Limit conditions in successive rows form a “logical “OR” relationship. In Figure 6-56 below, Limits 1, 2, and 3 have a “logical OR” relationship, while Limit 4 has multiple Limit conditions in a “logical AND” relationship.

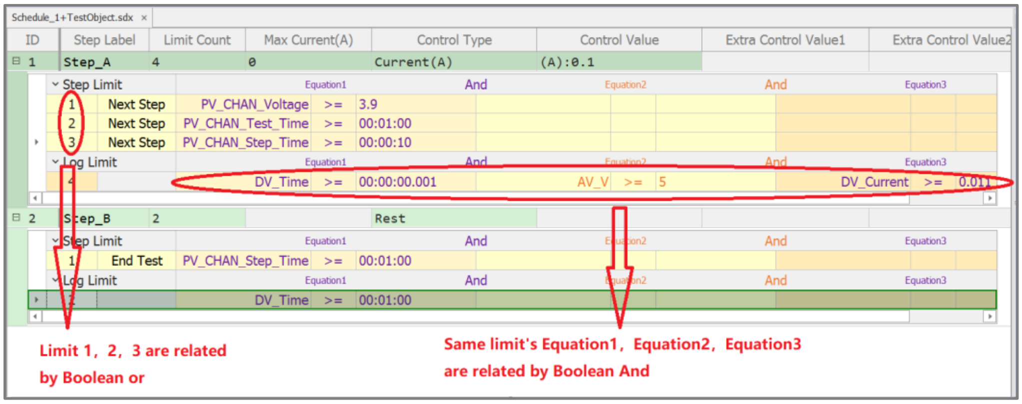


Figure 6-56 Logical Relationships Between Limit Conditions

Log Limits

When a test is running, the system stores the test data in a database. The Log Limit condition is what triggers the data collection and can be defined to record only the necessary data. Different Log Limits can be used for each step.

Of the parameters that are used to define Log Limit conditions, the most common are DV_Time, DV_Voltage, and DV_Current. These and other conditions are defined below.

1) DV_Time – Record data based on time intervals.
2) DV_Current – Record data based on current changes.
3) DV_Voltage – Record data based on voltage changes.
4) DV_PulseCycle – Record data based on pulse cycles.
5) DV_CCCV_TB_PulseInterval – Record data based on the CCCV_TB control type.

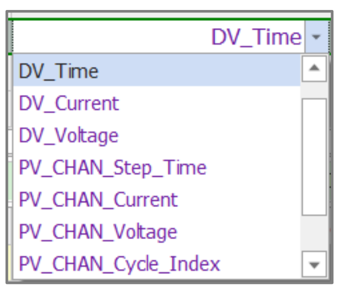


Figure 6-57 Parameters for Log Limits

Users can also use meta variables to set Log Limit conditions, including more complex conditions such as using a Formula (See **6.6 Create and Edit Formulas** for details).

Step and Limit Field Descriptions

The following table lists and describes the Step and Limit fields. Note that some fields are not shown in the above figure but are visible in the full-screen Step/Limit Page.

Step Field Name	Step Field Description
Step Label	This field is the name of the step. The step label may not be empty and can be edited.
Number of Limits	The total number of Limit (Step Limit and Log Limit) of this step is displayed. This field cannot be changed by the user.
Control Type	This field allows the user to select the appropriate control type for this step to determine what operation the instrument will perform.
Control Value	This field provides a set value or function for the selected control type. It can be a constant, a meta variable, a simulation file, or a formula.
Extra Control Value 1	This field will be enabled when the selected control type is current ramp, voltage ramp, power ramp, current staircase, voltage staircase, or electric power staircase.
Extra Control Value 2	This field will be enabled when the selected control type is voltage, voltage ramp, current staircase, voltage staircase, electric power staircase, or voltage (digital).
Max Current	This box refers to the hardware current range setting. The user can enter the maximum current value that may be required for this step, otherwise Mits X will automatically select a current range for the selected control value.
Extended Definition	When the selected control type is current or voltage pulse or voltage CV, this field can save the specified pulse or cyclic voltammetry (CV) tag.
Test Settings	Test Settings is to integrate the operation of the main IV channel and the auxiliary temperature, flow or digital input, the output channels provided for the third-party temperature control chamber or other auxiliary control boards (optional).
Burst Mode	Toggle the switch to enable or disable burst mode sampling.

Limit Field Name	Limit Field Description
Log Limit	When true, the software will record a data point.
Step Limit	When true, the current step will be terminated and the step indicated in the Goto step field will be executed.
Equation 1	It can be used in the equation of Step condition or Log condition.
Equation 2	Same as Equation 1
Equation3	Same as Equation 1

NOTE: Equations 1, 2, and 3 form a logical "AND" relationship.

6.5.2 Add and Delete a Step

Add a Step Using Grid Mode Methods

There are three ways to add a Step in Grid Mode:

1) From the Toolbar:
   a) Select an existing Step.
   b) Click on the “Add Step” icon on the Toolbar to insert a Step after the currently selected Step.
   c) Click on the “Insert Step” icon on the Toolbar to insert a Step after the currently selected Step.
2) From the Index Number:
   a) Move the cursor to the index number at the left end of the table next to the Step you want to add a Step after.
   b) Double-click the left mouse button to insert a Step after the currently selected Step.

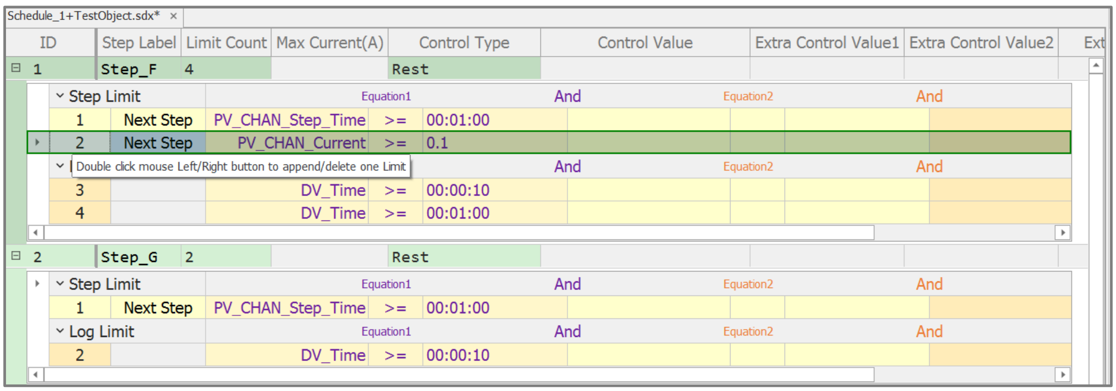


Figure 6-58 Add a Step from the Index Number

3) From the Step List:
   a) Right-click on the existing Step you want to add a Step after.
   b) Click on the “Add Step” option from the menu that appears to insert a Step after the currently selected Step.

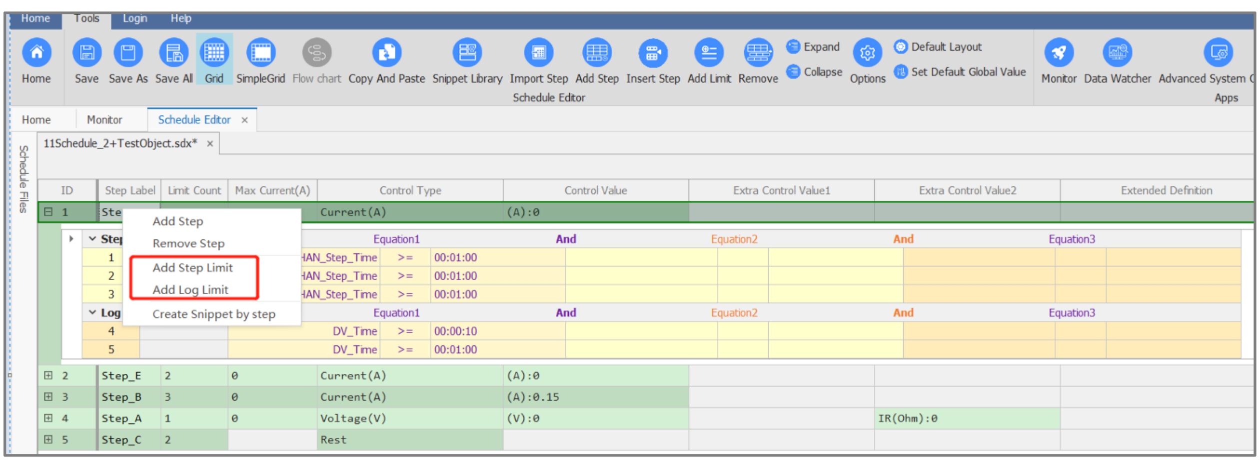


Figure 6-59 Add a Step from the Step List

Add a Step Using Simple Grid Mode Methods

In addition to the same three methods to add a Step in Grid Mode, there is fourth method in Simple Grid Mode:

1) Click the blank cell under the Control Type column in an existing Step.
2) Click on the “Add Step” option from the menu that appears to insert a Step after the currently selected Step.

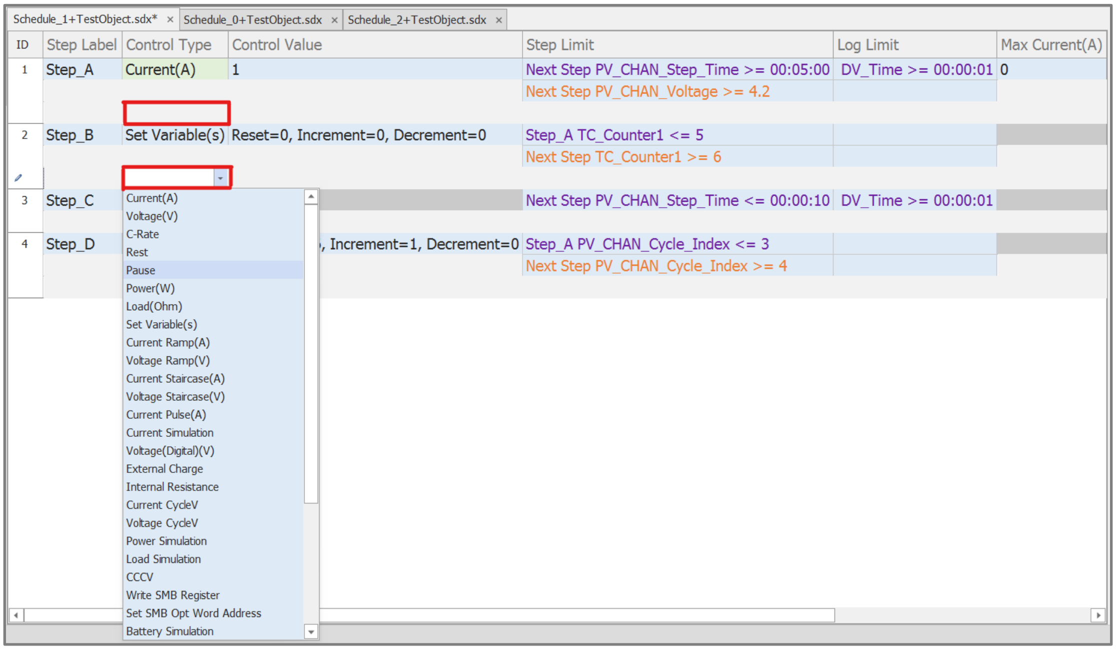


Figure 6-60 Add a Step in Simple Grid Mode

NOTE: The user can add multiple Steps to the Schedule, up to a maximum of 300 Steps.

Delete a Step Using Grid Mode/Simple Grid Mode Methods

There are three ways to delete a Step in both Grid Mode and Simple Grid Mode; the screenshots below show the methods in Grid Mode.

1) From the Toolbar:
   a) Select the existing Step that you want to delete.
   b) Click the “Remove” icon on the Toolbar to delete the currently selected Step.
2) From the Index Number:
   a) Move the cursor to the index number at the left end of the table next to the Step you want to delete.
   b) Double-click the right mouse button to insert a Step after the currently selected Step.

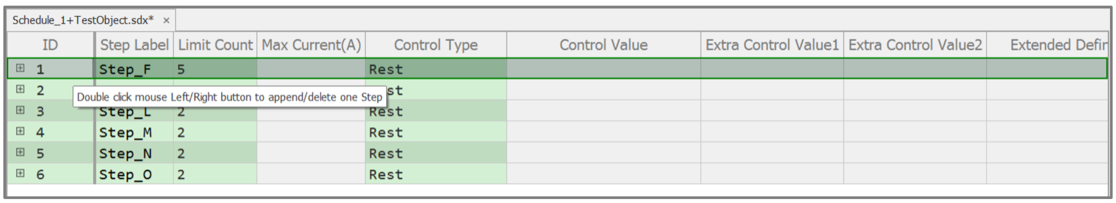


Figure 6-61 Delete a Step from the Index Number

3) From the Step List:
   a) Right-click on the Step you want to delete.
   b) Select the “Remove Step” option from the menu that appears to delete the currently selected Step.

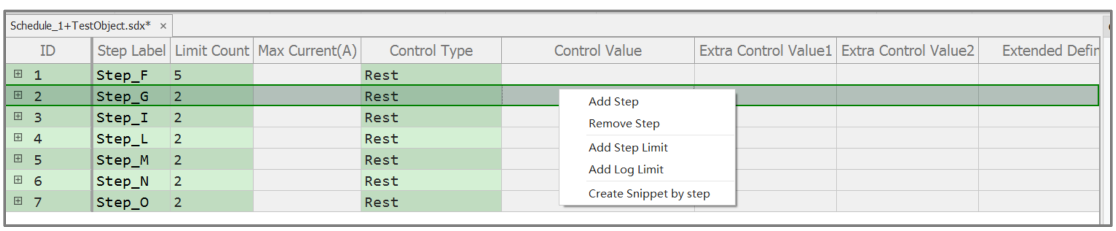


Figure 6-62 Delete a Step from the Step List

6.5.3 Add and Delete a Limit

Add a Limit Using Grid Mode and Simple Grid Mode Methods

There are three ways to add a Limit in both Grid Mode and Simple Grid Mode; the screenshots below show the methods in Grid Mode.

1) From the Toolbar:
   a) Select the existing Step Limit or Log Limit that you want to add a Limit after.
   b) Click on the “Add Limit” icon in the Toolbar to insert a Limit after the currently selected Limit.
2) From the Index Number:
   a) Move the cursor to the index number at the left end of the table next to the Step Limit or Log Limit you want to add a Limit after.
   b) Double-click the left mouse button to insert a Limit after the currently selected Limit.

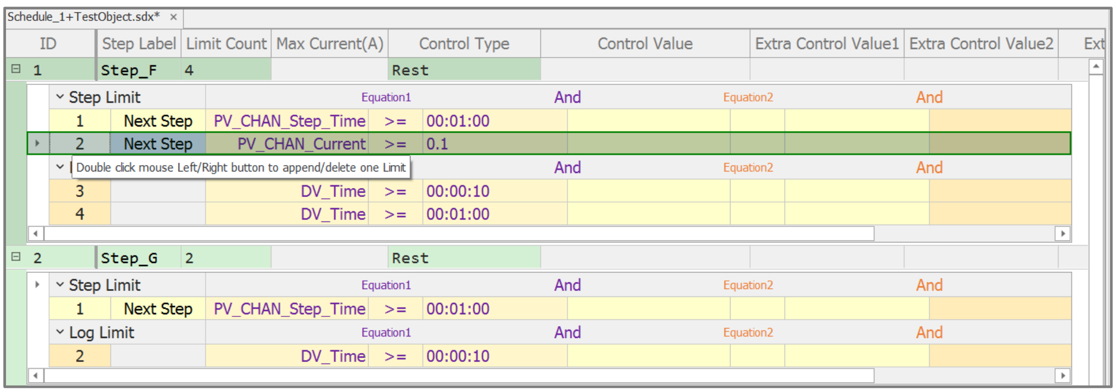


Figure 6-63 Add a Limit from the Index Number

3) From the Step List:
   a) Right-click the Step Label of the Step.
   b) Select the “Add Step Limit” or “Add Log Limit” option from the menu.

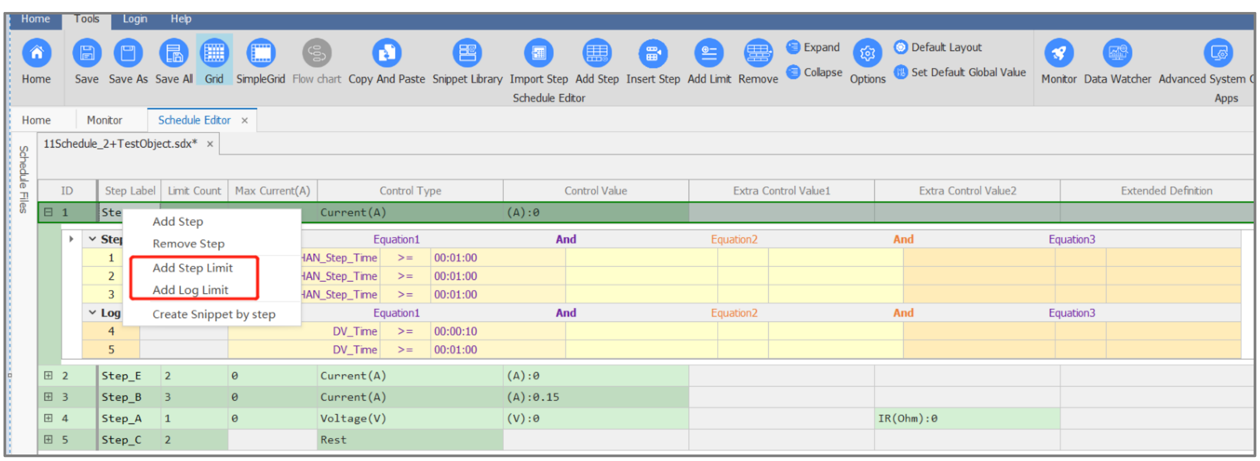


Figure 6-64 Add a Limit from the Step List

NOTE: The maximum number of Step and Log Limits (per Step) is 45.

Delete a Limit Using Grid Mode/Simple Grid Mode Methods

There are three ways to delete a Limit in both Grid Mode and Simple Grid Mode; the screenshots below show the methods in Grid Mode.

1) From the Toolbar:
   a) Select the existing Limit that you want to delete.
   b) Click the "Remove" icon on the Toolbar to delete the currently selected Limit.
2) From the Index Number:
   a) Move the cursor to the index number at the left end of the table next to the Limit you want to delete.
   b) Double-click the right mouse button to delete the selected Limit.

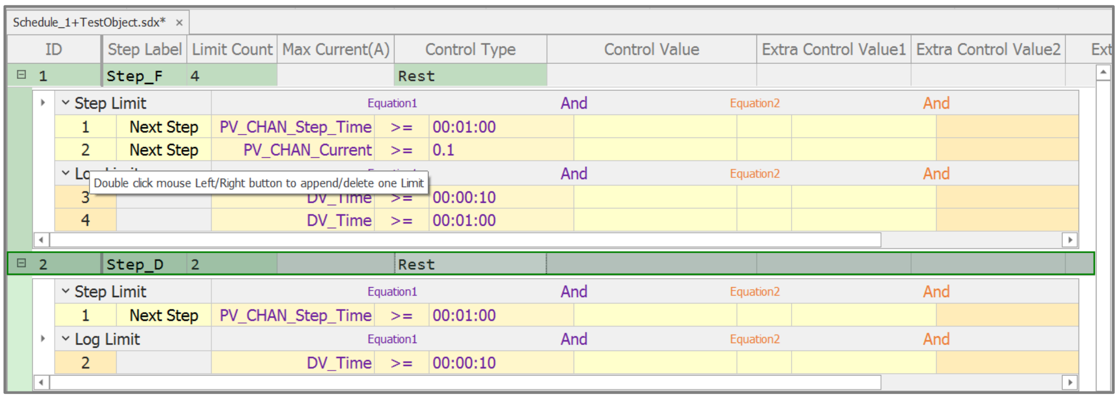


Figure 6-65 Delete a Limit from the Index Number

3) From the Step List:
   a) Right-click on the Step you want to delete.
   b) Select the "Remove Step" option from the menu that appears to delete the currently selected Step.

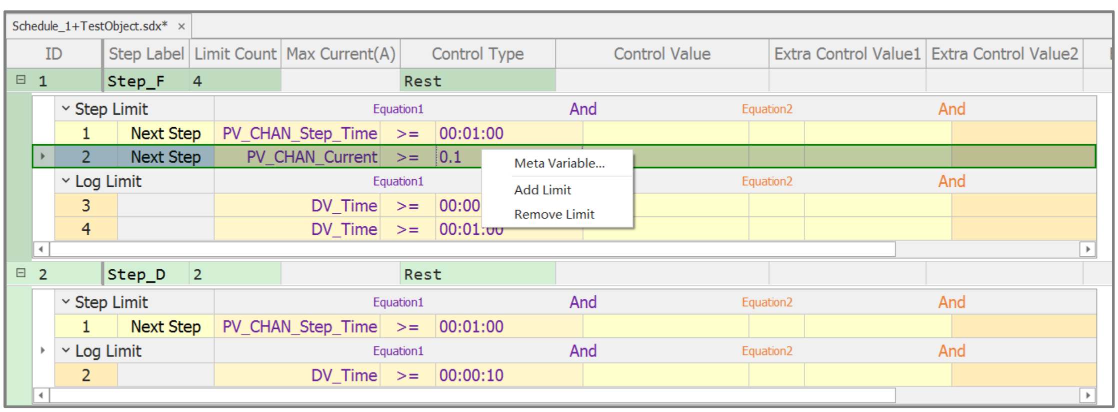


Figure 6-66 Delete a Limit from the Step List

6.5.4 Configure a Step

Manage the Schedule Interface Display

1) Drag the scrollbar at the bottom of the Schedule Interface left and right to view all the Step information.

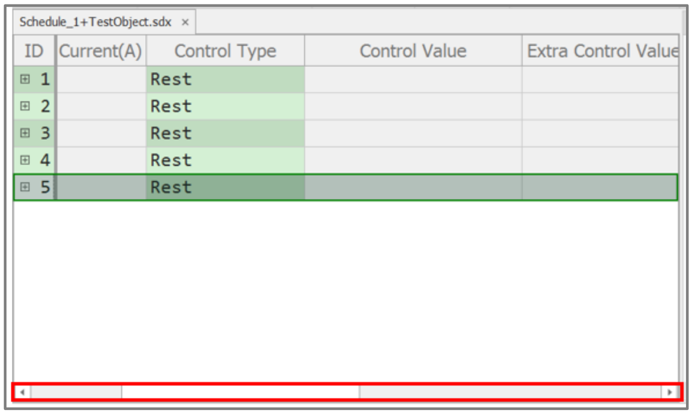


Figure 6-67 View Step Information

2) Press and hold the CTRL key on your keyboard and scroll your mouse wheel to adjust the font size.
3) Right-click the header of the Schedule Interface to open a menu with the following options: “Close,” “Close All But This,” “Close All,” and “Rename.”

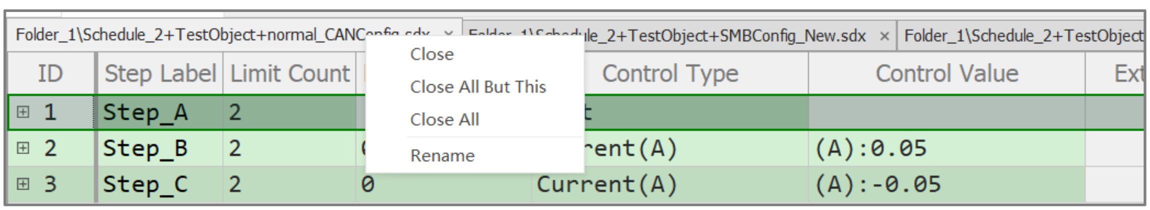


Figure 6-68 Right-click Menu in Schedule Header

4) You may use the Default Step Labels or you can rename a Step in the Step Label field.

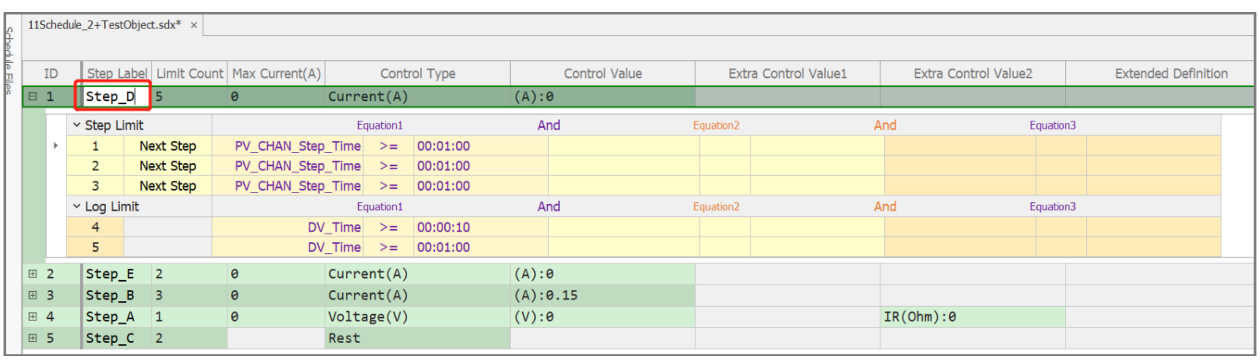


Figure 6-69 The Step Label Field

Configure the Controls

1) Select the Control Type.
   a) Click the field under the Control Type Column.
   b) From the drop-down menu that appears, select the appropriate Control Type.

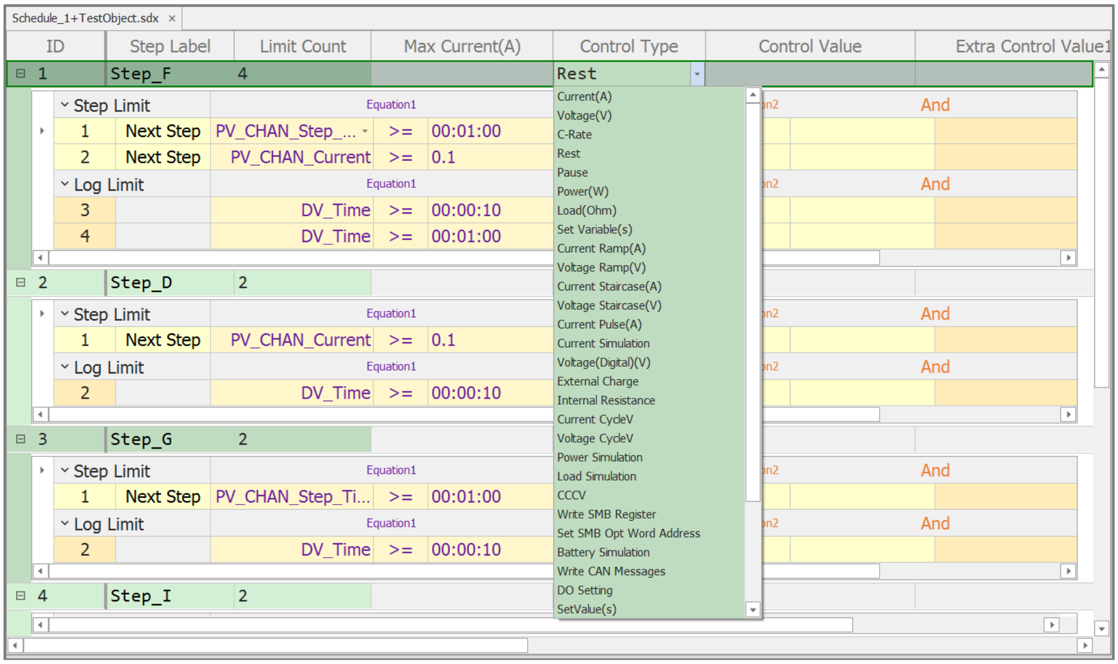


Figure 6-70 Select the Control Type

2) Enter the Control Value.
   a) Enter the desired value in the Control Value field corresponding to the Control Type.
   b) For Ramp and Staircase functions:
      i) The Control Value refers to the initial value.
      ii) The Extra Control Value1 field can be used to define the sweep rate of a Ramp function (dI/sec or dV/sec) or the DV(I)/stair of a Staircase function.
      iii) The Extra Control Value2 field can be used to define the stair time of the Staircase Control Type.

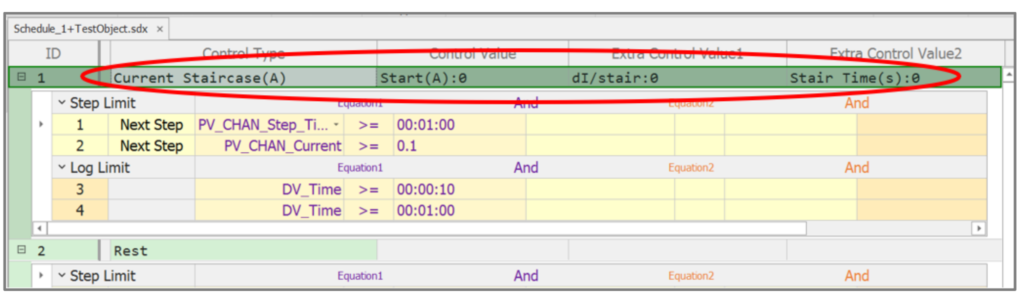


Figure 6-71 Enter the Control Value

Set the Maximum Current

It is important to set an appropriate value for the maximum current, Max Current (A), otherwise, the Mits X software will automatically match the current test range. For low current tests, setting a high range in Max Current (A) will reduce the resolution and accuracy.

Refer to the specifications of the hardware when setting the Max Current (A) value. The rated value of the hardware current value is marked on the front panel of the battery tester; this value varies by test equipment.

Set Special Control Types

Setting Pulse (Current Pulse), Cyclic Voltammetry (Current/Voltage CycleV) and Simulation Control (Current/Power/Load Simulation) types require the use of Extended Definition. Pulse and Cyclic Voltammetry can be created on the corresponding Pages of the Schedule file. Simulation Control requires the creation of an ASCII file containing the basic data set.

For a more detailed description of these controls, refer to **6.7 Program Pulse Control** and **6.8 Program Cyclic Voltammetry**.

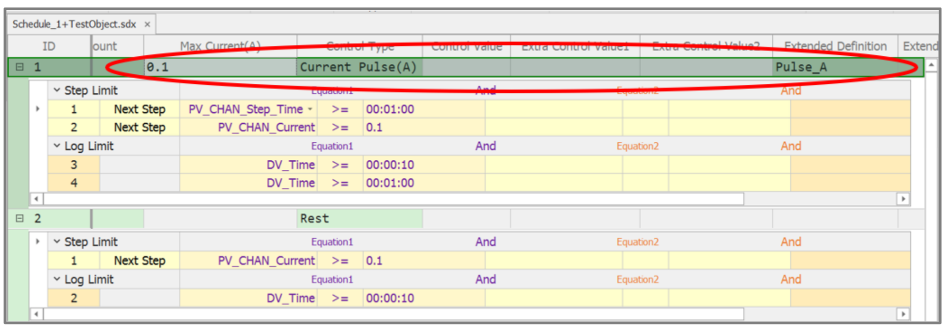


Figure 6-72 Set Special Control Types

6.5.5 Add and Edit Step/Log Limit Conditions

Edit a Step/Log Limit Condition

1) Click on the “Expand” icon in the Schedule File Toolbar to display the Detailed View or click the icon before the Step you want to edit to view the Limits for that Step.
2) Drag the scrollbar below each Step left and right to view the full Step and Limit details.

Figure 6-73 Edit a Step/Log Limit Condition

3) Click on “Next Step” in the Step Limit option and use the drop-down menu that appears to select the Step to be executed when the Step Limit for the current Step is reached.
   a) **Same Step** – Repeat the current Step control.
   b) **Next Step** – Jump to the next Step.
   c) **End Test** – End the test.
   d) **Unsafe** – When the current Step Limit is reached, the system will report as Unsafe and stop the Test.
   e) **Step_B, Step_D, Step_E** – Jump to Step_B, Step_D, Step_E, respectively.

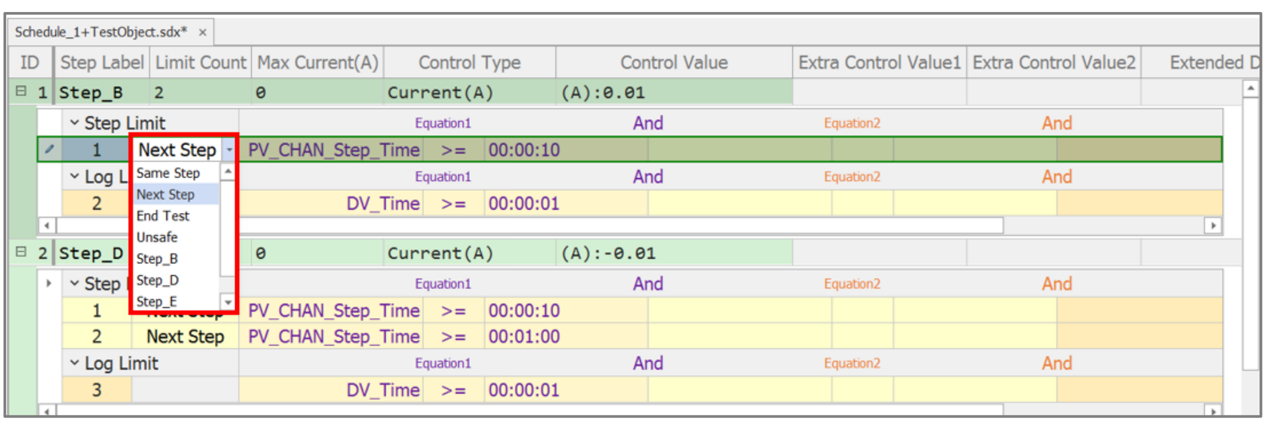


Figure 6-74 Select the Next Step

4) Select the meta variable.
   a) Click the cell “PV_CHAN_Step-Time" on the left under Equation1.
   b) From the menu of commonly-used meta variables that appears, select the meta variable that you want to use.

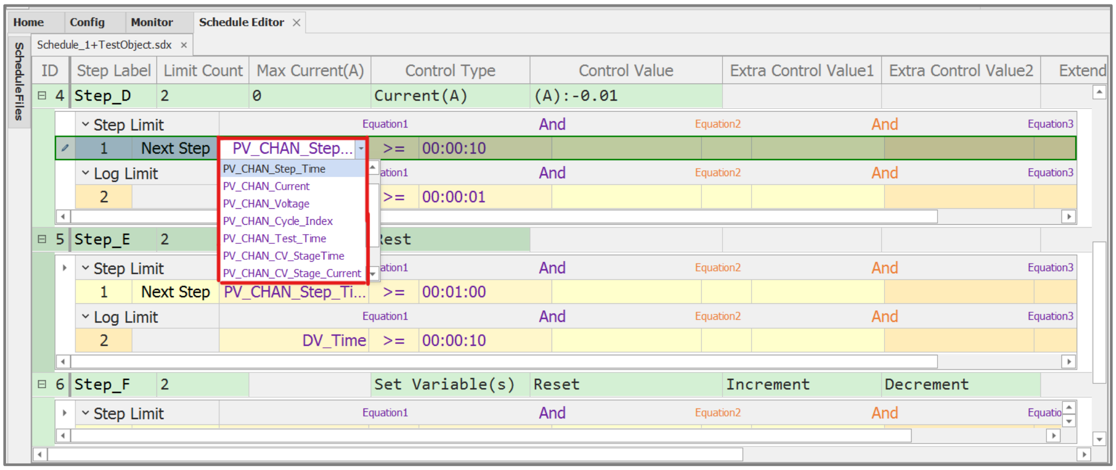


Figure 6-75 Select the Meta Variable

   c) Use other meta variables.
      i) Select “More...” from the list of commonly used meta variables.
      ii) From the Meta Variables Interface that appears, select the appropriate meta variable
      iii) Click on the “OK” button on the Interface to return to the Step/Limit Page.

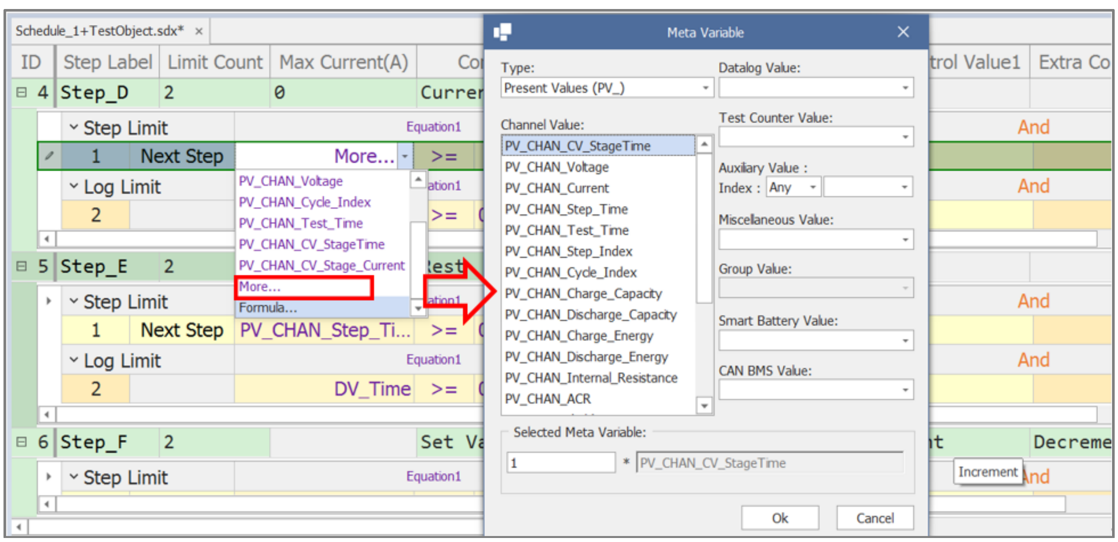


Figure 6-76 Use Other Meta Variables

d) Use a formula.
   i) Select "Formula" from the list of commonly used meta variables.
   ii) From the Formula Interface that appears, select the appropriate formula.
   iii) Click the "OK" button on the Interface to return to the Step/Limit Page.
   iv) For formula information, refer to **6.6 Create and Edit Formulas**.

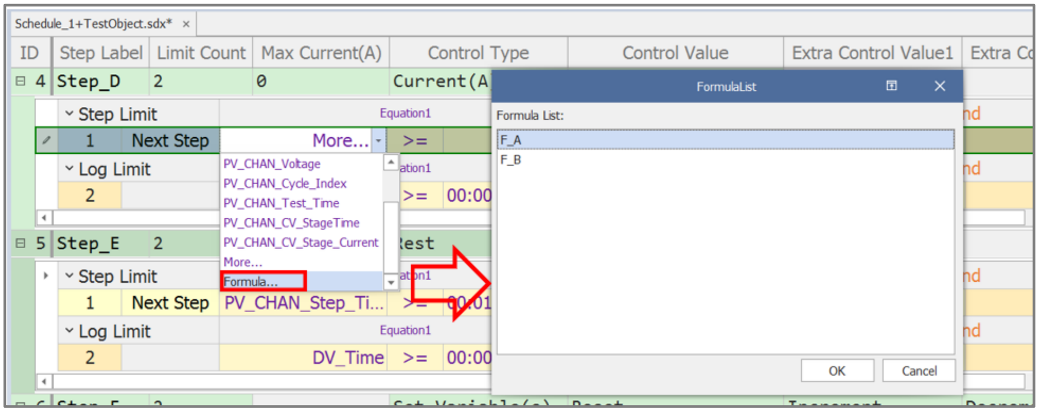


Figure 6-77 Use a Formula

5) Click the middle cell ">=" under Equation1 and select an appropriate comparison symbol from the drop-down menu.

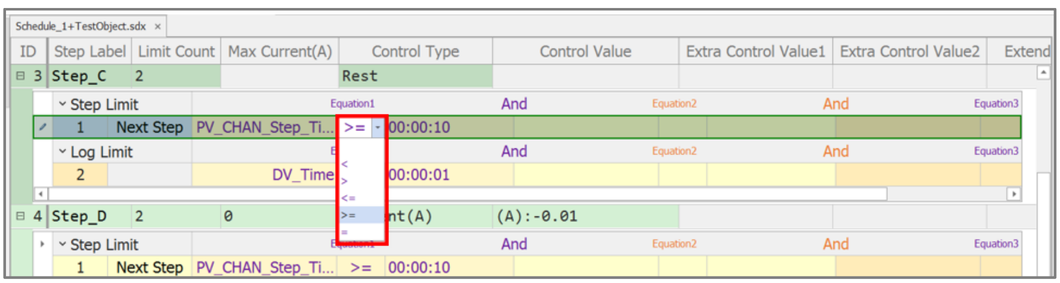


Figure 6-78 Select the Comparison Symbol

6) Click the cell on the right under Equation1 and fill in the appropriate conditions based on the selection in the cell on the left. You can also use meta variables or formulas: right-click on the cell and select "Meta Variable" or "Formula" from the menu that appears.

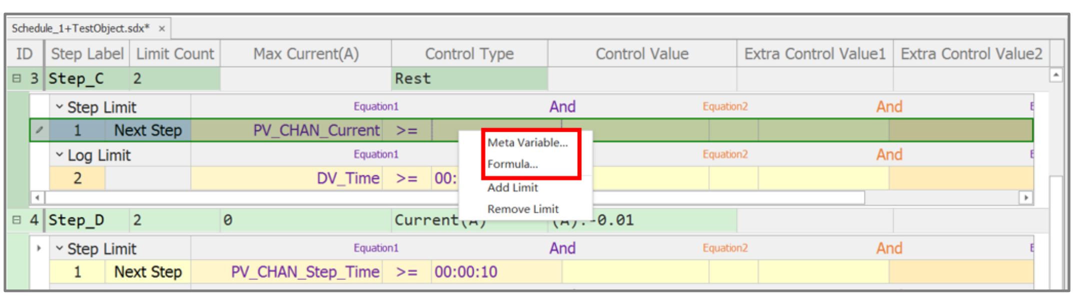


Figure 6-79 Use a Meta Variable or Formula

7) Log Limits are set the same way as Step Limits (above); the only difference is that Log Limits do not have "Next Step."

Add a "logical AND" Limit Condition

Repeat steps 4-6 above to add a "logical AND" Limit condition.

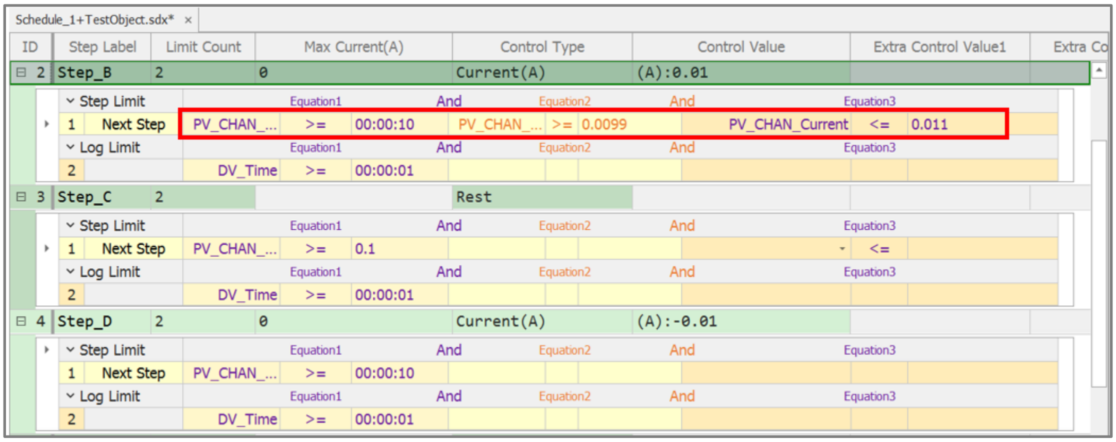


Figure 6-80 Add a Logical "AND" Limit Condition

Example: As shown in Figure 6-81 below, the "logical AND" Log Limit condition means that the Log Limit of Step_A will collect data that meets the time change of at least 60 seconds and the current change of at least 0.1 A during the Test.

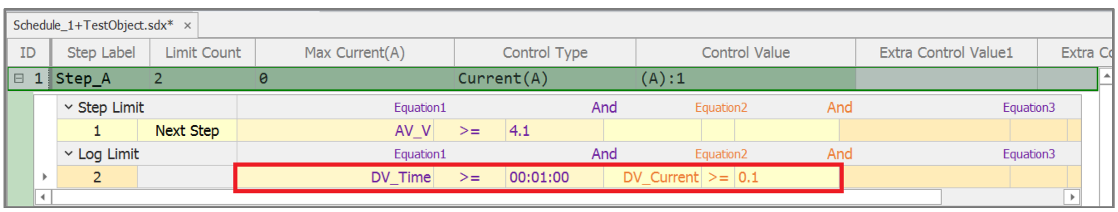


Figure 6-81 Log Limit of Step_A with "Logical AND" Limit Condition

Add a "logical OR" Limit Condition

1) Left-click on the index number to the left of the Limit.
2) Add a Limit.
3) Repeat steps 4-6 above to add a "logical OR" Limit condition.

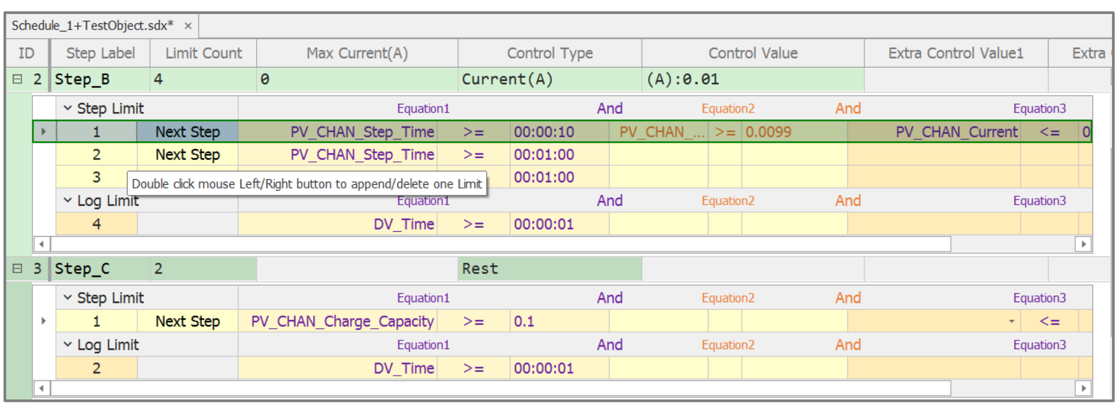


Figure 6-82 Add a Logical "OR" Limit Condition

EXAMPLE: As shown in the Figure 6-83 below, the “logical OR” Log Limit condition means that the Log Limit of Step_A will record a data point every 20 seconds, every 0.3 V voltage change, or every 0.1 A current change during the Test.

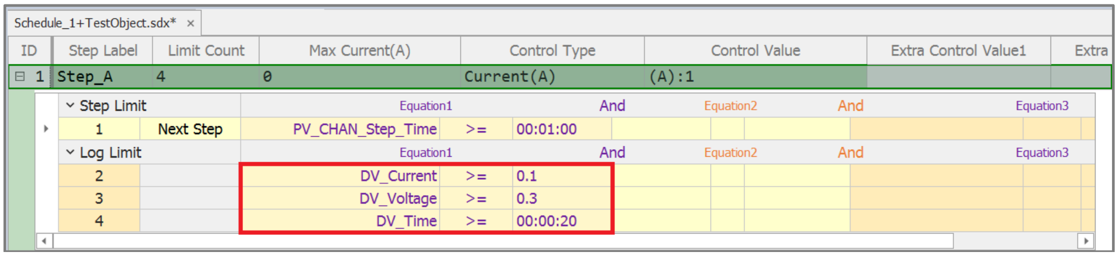


Figure 6-83 Log Limit of Step_A with “Logical OR” Limit Condition

Set a Step/Log Limit Condition from an Auxiliary Value

Auxiliary sampling values can be used for Step Limit conditions, including auxiliary voltage, temperature, pressure, and other values.

EXAMPLE: Select a temperature AV_T[1] (auxiliary temperature, virtual index 1) from the Meta Variable Interface as the Step Limit condition.

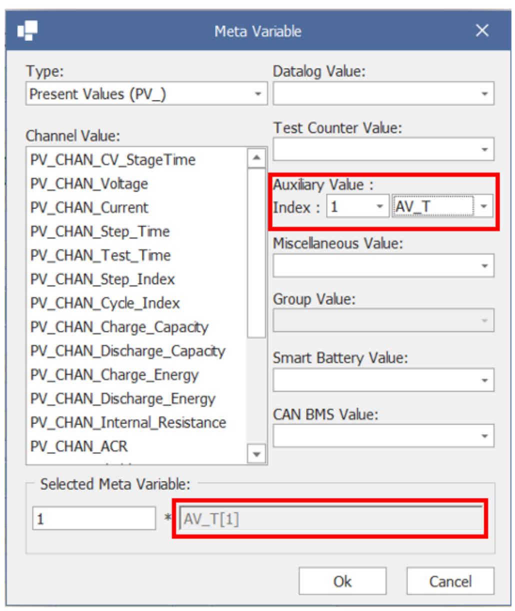


Figure 6-84 Set a Step/Log Limit Condition from an Auxiliary Value

As shown in Figure 6-85 below, AV_T[1] is used in a Test Schedule, so when the temperature sampling value exceeds 40° C, the Test will jump to the next Step.

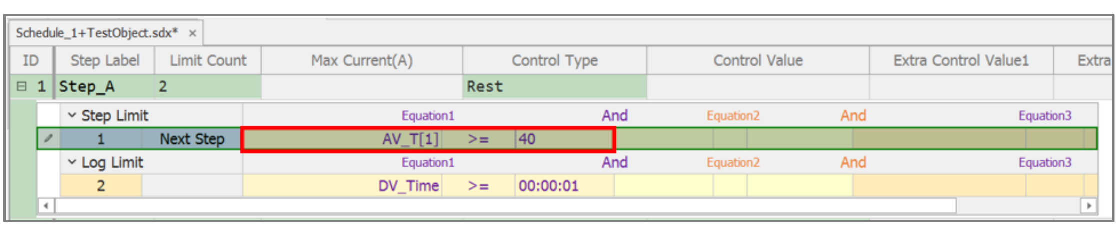


Figure 6-85 Reference the Auxiliary Temperature with Virtual Index 1

The unique virtual index “Any” can be used for any auxiliary type displayed in the auxiliary type drop-down list. If you select any auxiliary voltage as the virtual index of the auxiliary voltage (Figure 6-86), when any auxiliary voltage mapped to the main IV channel meets the Limit condition, “Next Step” will take effect.

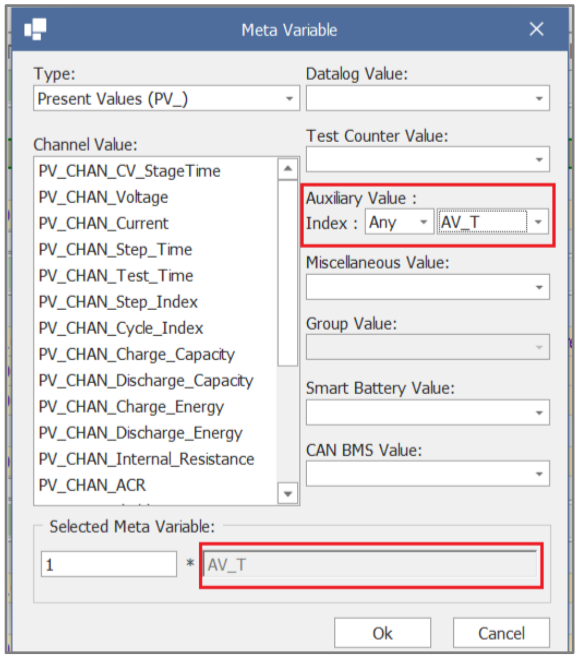


Figure 6-86 Select the Auxiliary Temperature with a Virtual Index of 1 from the Meta Variable Interface

As shown in Figure 6-87 below, an auxiliary voltage with virtual index Any is selected from the Meta Variable Interface AV_V.

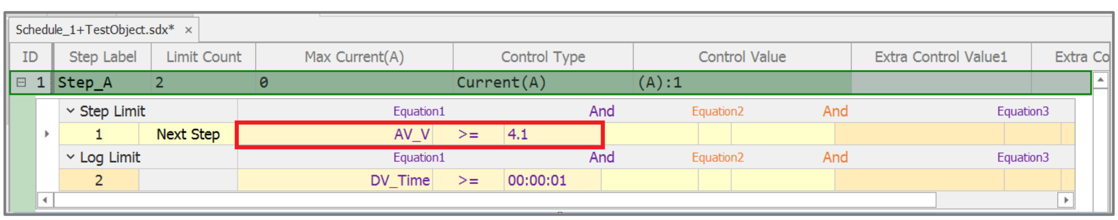


Figure 6-87 Quoting the Auxiliary Voltage with a Virtual Index of Any

NOTE: It is important to pay attention to the difference between AV_V[1] and AV_V. AV_V[1] refers to the virtual index number of 1, while AV_V represents the virtual index number of Any.

EXAMPLE: As shown in Figure 6-86 above, the virtual index Any is selected in the Test Schedule. Therefore, when any auxiliary voltage mapped to the main IV channel exceeds 4.1 V, the Test enters the next Step.

APPLICATION EXAMPLE: When 56 battery packs are charged in series, when any battery voltage (auxiliary) exceeds the maximum voltage or is lower than the cut-off voltage, the Test must enter a different action, stop, rest, or jump. In this example, a virtual index of Any is used to facilitate this control.

6.5.6 Set an Execution Loop

Introduction to Cycle Index

You can run a test loop sequence by using "Cycle_Index," which will loop for a specific number of iterations.

NOTE: Cycle time is a function used in earlier versions of Mits software, but this option is no longer available and has been replaced by "Cycle_Index" and "TC_Counterx."

Cycle – "Cycle_Index" is the timetable range index of the iteration shared by all steps. It can be regarded as a global variable of the Schedule File. Unlike the previous cycle times, "Cycle_Index" is recorded in the Cycle_Index column in the results database. "Cycle_Index" is initialized to 1, and can be increased by 1 each time in the Set Variable(s) Step. To increase "Cycle _Index," a Set Variable(s) control step must be added.

Use Cycle Index to Set an Execution Loop

Using "Cycle_Index," you can create a flexible and complex schedule. The following example shows a simple loop in which Cycle_Index is incremented from 1 to 3.

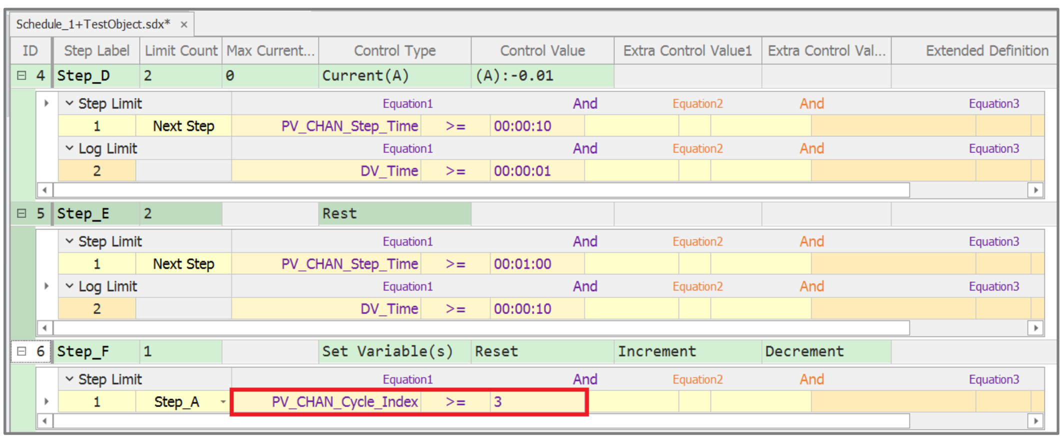


Figure 6-89 Cycle Index Incremented from 1 to 3

Note the Control Type Set Variable(s) in Step_F. This step generates Cycle_Index increments according to Figure 6-90 below. The drop-down menu under the Extra Control Value 1 heading allows you to select the index, which will be updated every cycle.

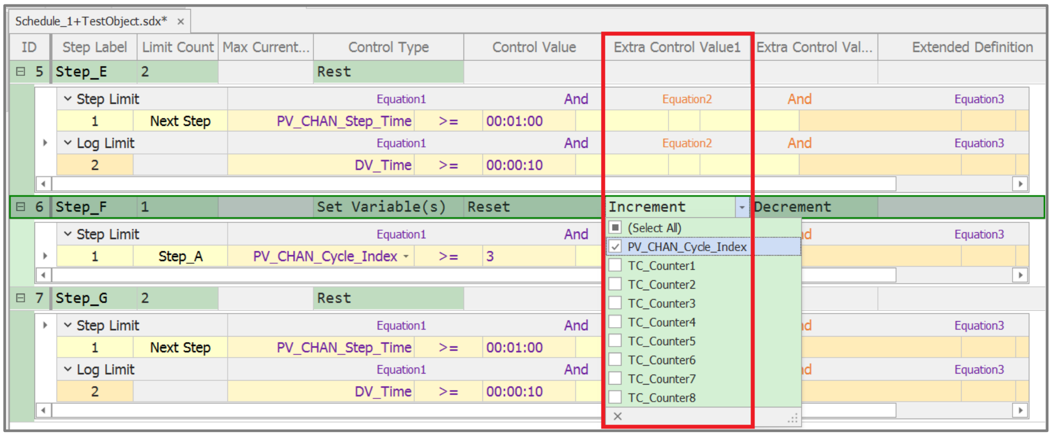


Figure 6-90 Set Variable(s) Increment Drop-Down Menu

The following example uses TC_Counter x (x=1) and Cycle_Index to create a Schedule. This Schedule is a nested loop Test, where Step_A is in the innermost loop and is done 5 times; Step_B is in the outermost loop. The Schedule will iterate from Step_A again 3 times.

NOTE: Cycle_Index increased from 1 to n, while TC-Counter x increases from 0.

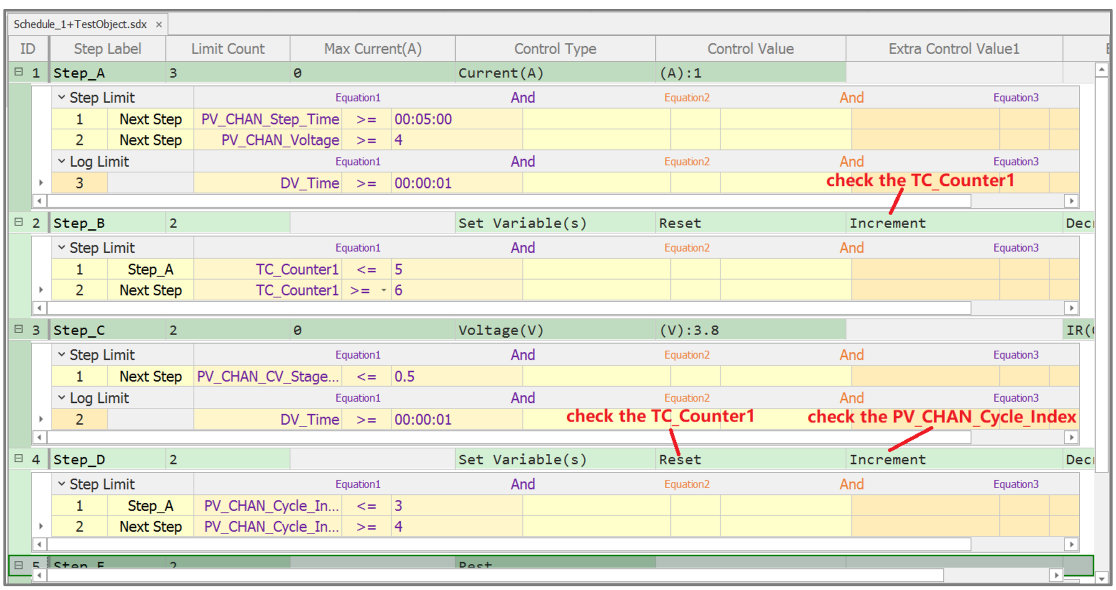


Figure 6-91 Use TC_Counter x (x=1) and Cycle_Index to Create a Schedule

There are many other ways to use execution loops. Please contact Arbin Customer Support for tips and help with other applications.

6.6 Create and Edit Formulas

6.6.1 Introduction to Formulas

Mits X allows you to create a Formula for your particular application, which can then be used in place of variables as a control value.

Formulas include General Formulas and Advanced Formulas.

General Formulas:

1) Are designed to meet most formula needs.
2) Have a fixed logical order.

Advanced Formulas:

1) Can be used to write more complex formulas.
2) Have the ability to use different operators to edit formulas according to the desired logic, for greater flexibility.
3) Support longer formulas.

The formula interface is shown in Figure 6-92 below.

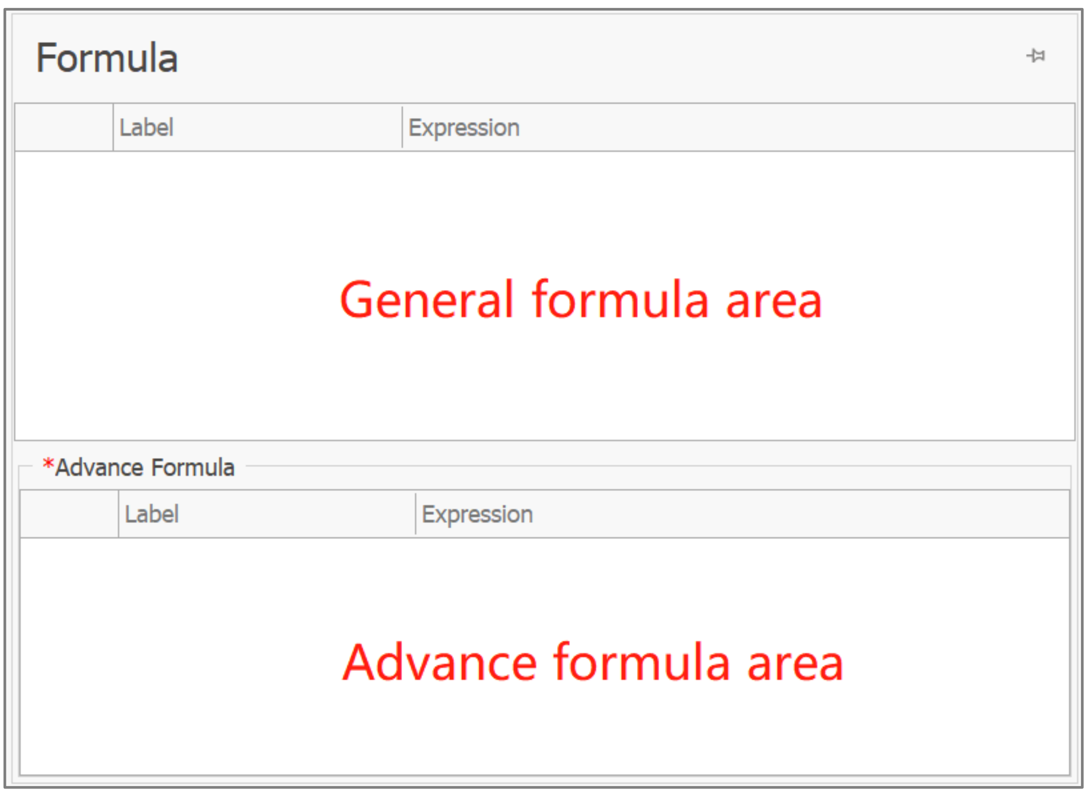


Figure 6-92 Formula Interface

When you select the Formula in the Advance Feature tab of Advance System Config, the Formula Function in Mits X is enabled, and a Formula Page is displayed in the Schedule File Editor Interface.

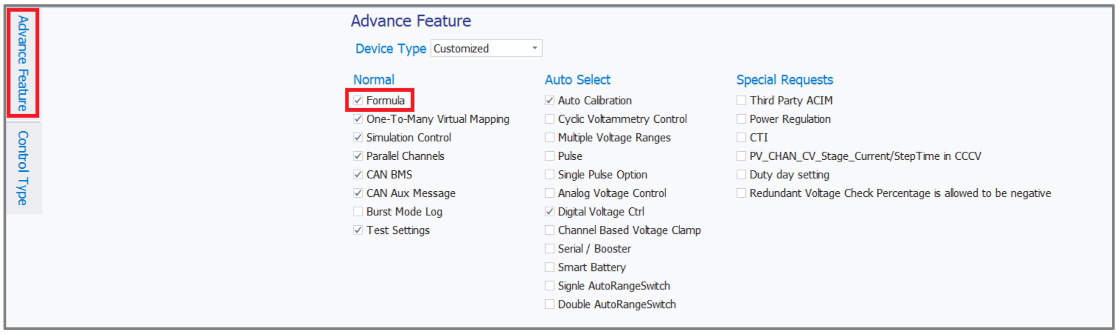


Figure 6-93 Enable the Formula Function in the Advance Feature Tab

Figure 6-94 below shows an example Formula: F_A: ΔV (dV) as the charging end condition of the Ni-Cd battery.

Formula

	Label	Expression
1	F_A	PV_CHAN_Voltage*1-PV_CHAN_VmaxOnCycle*1
2	F_B	ABS(PV_CHAN_Voltage*1-PV_CHAN_VmaxOnCycle*1)
3	F_C	LOG10(ABS(PV_CHAN_Voltage*3*4.5-PV_CHAN_VmaxOnCycle*31/0.02))

Figure 6-94 Example Formula

In F_A, X1=X2=X3=X4=Y1=Y2=Y3=1, then use "-" and no other Functions are used. Figure 6-94 also shows two example Formulas F_B and F_C using Functions.

Below is an example of an Advanced Formula.

*Advance Formula

	Label	Expression
1	AF_A	SIN(45) * PV_CHAN_Step_Time+MV_UD12-SMB_MV_RX3/CAN_MV_RX7+(TC_Counter8-PV_CHAN_Voltage+DV_Current)-(MV_SpecificCapacity+LC_CHAN_VmaxOnCycle)*ABS(LS_CHAN_Current)-LC_CHAN_Test_Time
2	AF_B	(PV_CHAN_Current- 3.14)^ 1 + (PV_CHAN_Voltage- 3.14)^ 2 - (PV_CHAN_Current- 3.14)^ 3 *(PV_CHAN_Test_Time- 3.14)^ 5

Figure 6-95 Example Advanced Formula

6.6.2 Add and Manage General Formulas

Open the Formula Interface

1) Click the Formula tab on the right side of the Schedule Page.

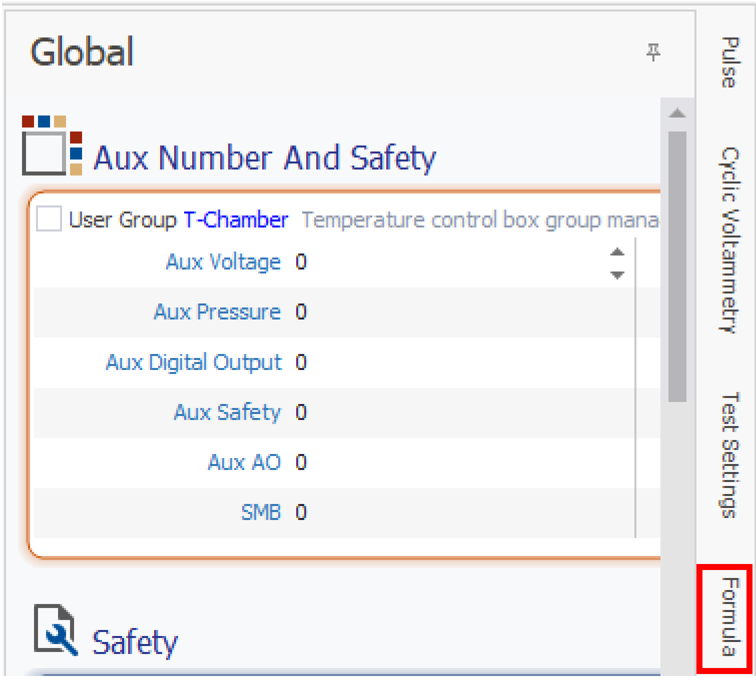


Figure 6-96 Formula tab on the Schedule Page

2) The first four buttons on the Formula Interface toolbar are the options for using General Formulas:
   a) **Import Formula** – Import a General Formula from another Schedule File.
   b) **Add Formula** – Add a new General Formula in the last row of the list.
   c) **Insert Formula** – Insert a new General Formula right before the selected Formula.
   d) **Remove** – Delete the selected General Formula(s).

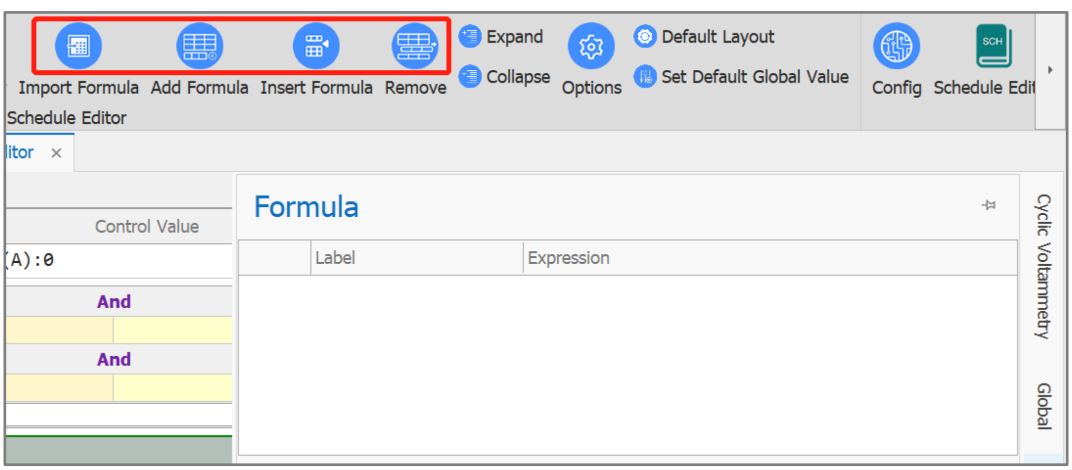


Figure 6-97 Toolbar Buttons for General Formulas

3) You can also access the following Formula options by right-clicking in the Formula list space:
   a) Right-click in the blank Formula space:
      i) **Insert Formula** – Insert a new General Formula right before the selected Formula.
      ii) **Import Formula** – Import a General Formula from another Schedule File.

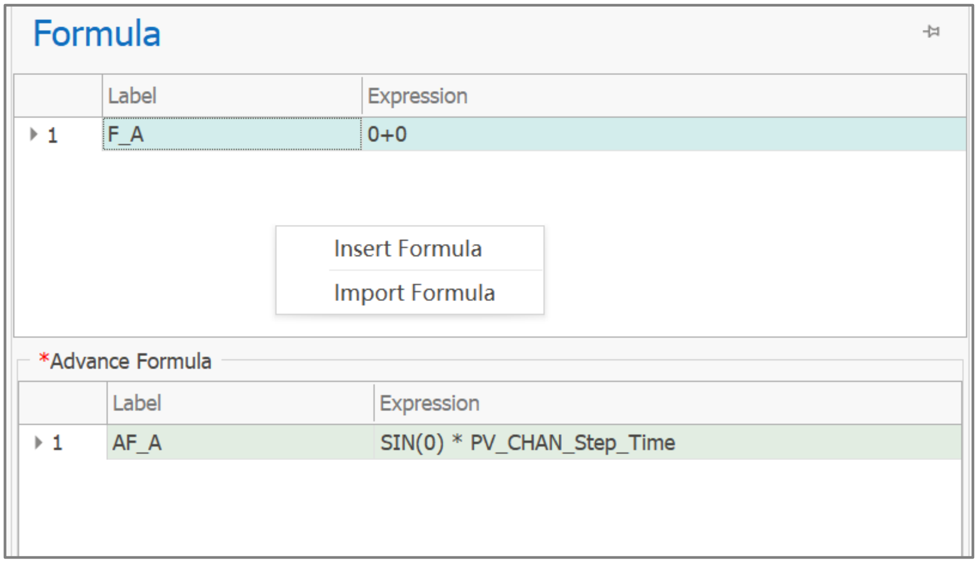


Figure 6-98 Right-Click Menu for the General Formula Space

   b) Right-click on an existing Formula in the Formula list space:
      i) **Insert Formula** – Insert a new General Formula right before the selected Formula.
      ii) **Append Formula** – Add a new General Formula to the end of the Formula list.
      iii) **Remove Formula** – Delete the selected General Formula.
      iv) **Copy and Paste** – Copy the selected Formula content, which can then be pasted onto an existing Formula to overwrite the original content.
      v) **Import Formula** – Import a General Formula from another Schedule File.

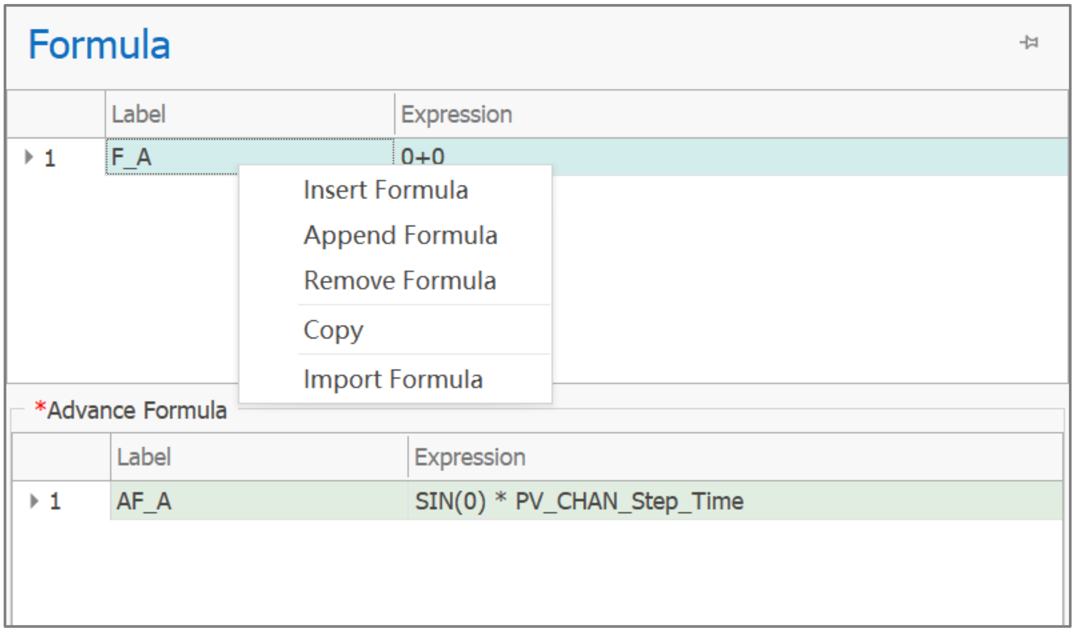


Figure 6-99 Right-Click Menu for the Selected General Formula

NOTE: A maximum of 64 Formulas are allowed. A maximum of 16 Formulas can be nested consecutively.

Add a General Formula

There are several ways to add a General Formula:

1) Add the first Formula to the Formula space:
   a) Click on the "Add Formula" button on the Formula Toolbar.
   b) Right-click on the space in the Formula List and click on the "Insert Formula" option.
2) Import from another Schedule File:
   a) Click on the "Import Formula" button on the Formula Toolbar to open the Formula List interface, then select the Formula you want to import.
   b) Right-click on the Formula List or empty Formula space, click on the "Import Formula" to open the Formula List interface, then select the Formula to import.
3) Before the selected Formula:
   a) Click on a Formula from the Formula List to select it, then click on the "Insert Formula" button on the Formula Toolbar.
   b) Right-click on a Formula from the Formula List, then click on the "Insert Formula" option.
4) After the selected Formula:
   a) Right-click on a Formula from the Formula List, then click on the "Append Formula" option.
   b) Double-click on the Index Number of a Formula to add another General Formula after it.

Rename a General Formula

1) Click on the text under the "Label" field for the General Formula to be renamed.
2) Type in the new name of the General Formula.

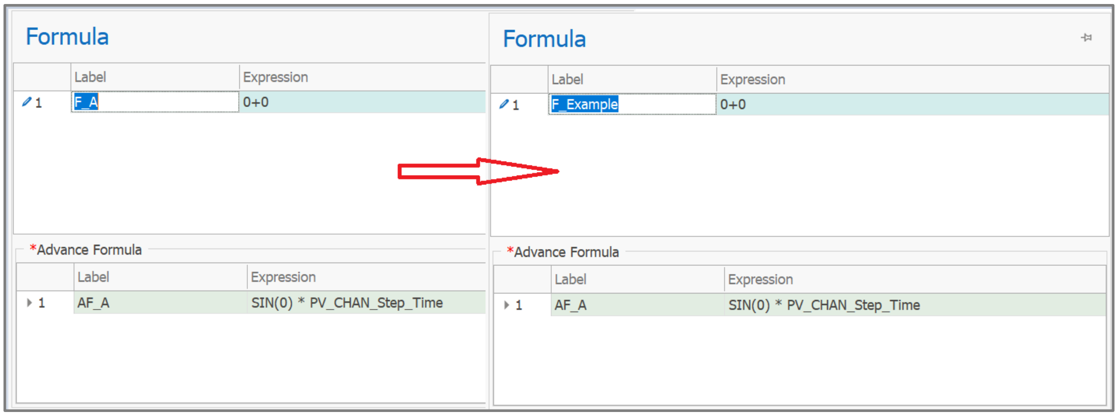


Figure 6-100 Rename a General Formula

Edit a General Formula

1) Click the “Expression” field of a General Formula to enter the Formula Edit Page for that Formula.

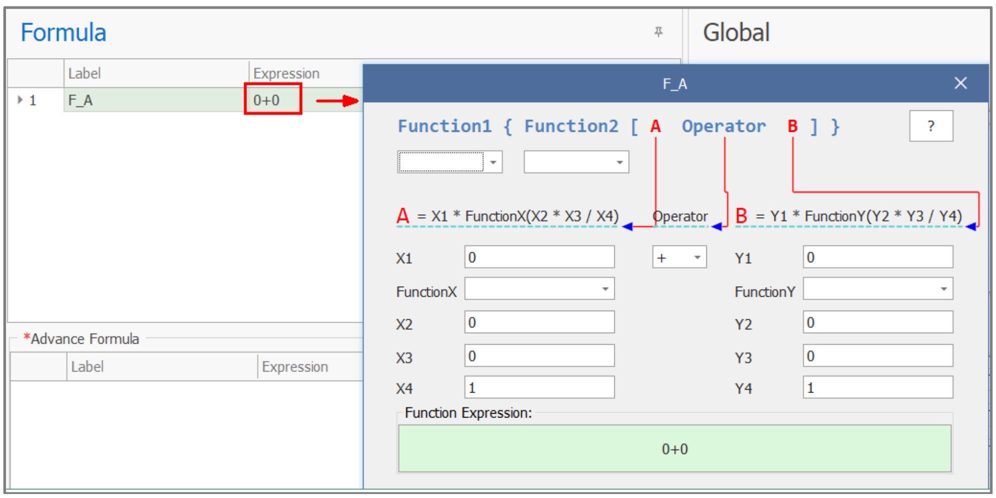


Figure 6-101 Click the “Expression” Field of a Formula to Edit the Formula

2) Define the value of X1, X2, X3, X4, Y1, Y2, Y3, and Y4.
3) These can be a numerical value, a Metavariable, or a Formula.
4) You can directly enter the numerical value in the edit box of X(i) or Y(i).

NOTE: If X1, X2, X3, Y1, Y2, or Y3 are set to 0, this will cause the corresponding item to be invalid.

5) To use a Metavariable or formula, right-click the field under X(i) or Y(i), then select the appropriate Metavariable from the Metavariables dialog or select the appropriate Formula from the Formula list.

For a detailed description of all meta variables, refer to Appendix B: Meta Variables.

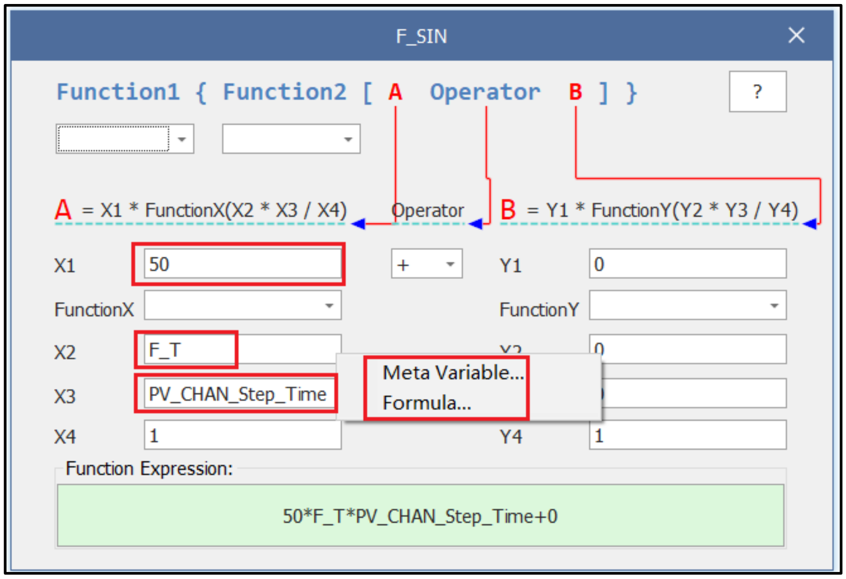


Figure 6-102 Numerical Value, Metavariable, and Formula for X(i) and Y(i)

6) Select a Function.
    a) Click the field under Function1, Function2, FunctionX, or FunctionY.
    b) Select a Function from the drop-down list that appears.

NOTE: You can view the Function definition by clicking on the "?" button in the upper right corner of the Formula Edit Interface.

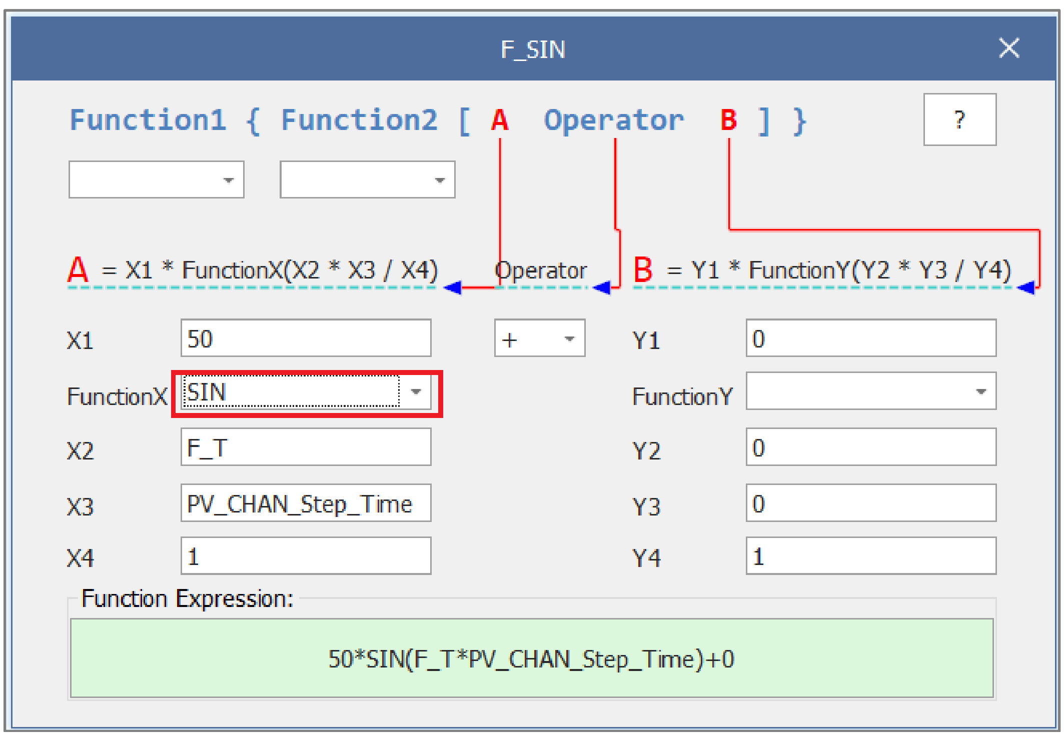


Figure 6-103 Use Functions in a Formula

Functions can be selected from the options below.

Function	Limit Field Description	Example
ABS	Returns the absolute value of a number.	ABS(x) = |x|
ACOS	Returns the arc cosine of a number expressed in radians. The value range is 0 to pi.	ACOS(x)
ASIN	Returns the arc sine of a number expressed in radians.	ASIN(x)
CEILING	Returns smallest integer greater than or equal to given number.	CEILING (2.99) = 3
COS	Returns the cosine value of an angle.	COS(x)
CUBIC	Returns the cube of a number.	x^3
EVEN	Rounds a number to the nearest even number. Negative numbers are adjusted from zero.	
EXP	Returns the power of a given number.	EXP (n) = e^n
FACT	Returns the factorial of a number.	
FLOOR	Returns largest integer less than or equal to given number.	
INT	Rounds a number to the nearest whole integer.	
LN	Returns the natural logarithm of a number.	ln(x)
LOG10	Returns the base 10 logarithm of a number.	log10(x)
ODD	Rounds a number to the nearest odd number.	
RANDOM	For positive numbers, returns a uniformly distributed number that is greater than or equal to 0 and less than or equal to given number; for negative numbers, returns a uniformly distributed random number that is less than or equal to 0 and greater than or equal to given number.	
SIGN	Returns the sign of the number. If the number is positive, it returns 1; if the number is zero, it returns 0; if the number is negative, it returns –1.	SIGN (+1) = 1 SIGN (0) = 0 SIGN (-1) = -1
SIN	Returns the sine of an angle.	SIN(x)
SQR	Returns the square of a number.	
SQRT	Returns the positive square root of a number.	SQRT (X) = x^1/2
TAN	Returns the tangent of an angle	tan(x)

TRUNC	Returns the integer of the number by deleting the decimal part of the number.	TRUNC (2.2) = 2

7) Select an operator.
   a) Click the field under Operator.
   b) Select the Operator from the drop-down list that appears.

You can view the final form of the created Formula in the field under Formula Expression. You can create as many Formulas as you want with different degrees of complexity.

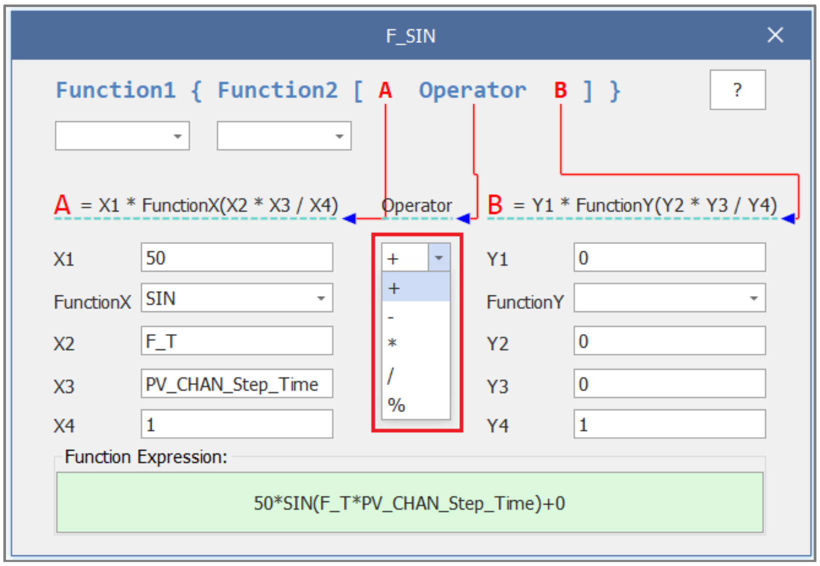


Figure 6-104 Select an Operator.

Operators include: + - * / %. For %: When the first operand is divided by the second operand, the modulus operator returns the remainder.

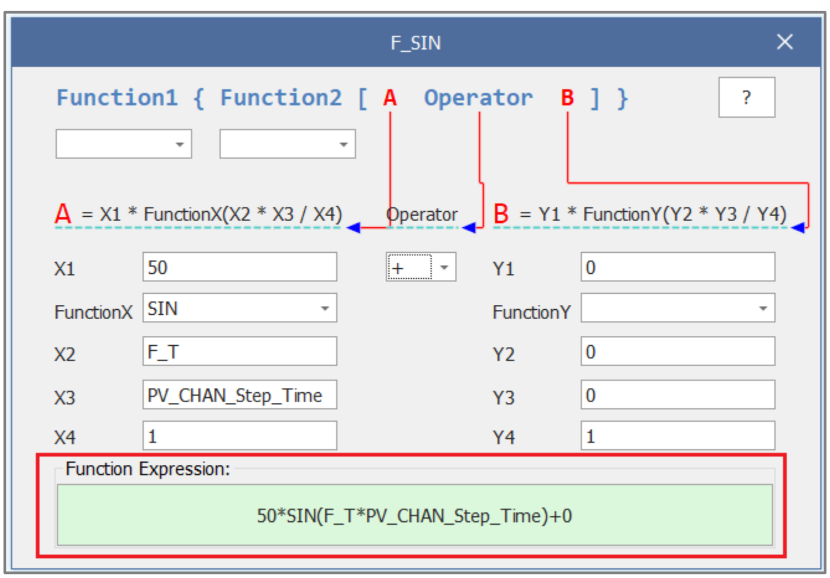


Figure 6-105 Example of the Final Function Expression

Note that the default value for each of the X and Y parameters is "0". The user must specify "1" for each variable to prevent either term in the expression from being erased.

Invoke a General Function in a Schedule

1) Right-click on the Control Value field or Limit edit box to open the pop-up menu.

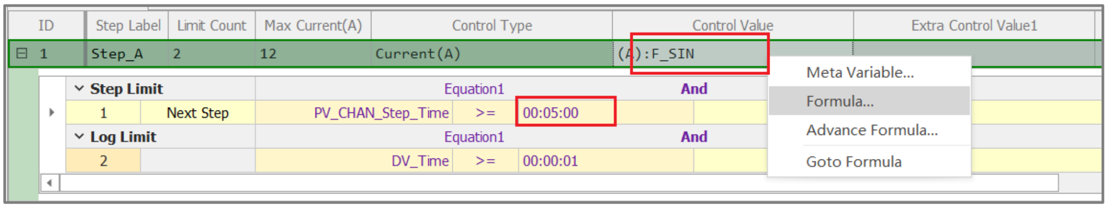


Figure 6-106 Invoke a General Formula in a Step

2) Click the Formula option to open the General Formula List Interface.
3) Click on a General Formula from the list to select it.
4) Click the “OK” button at the bottom of the General Formula List Interface.

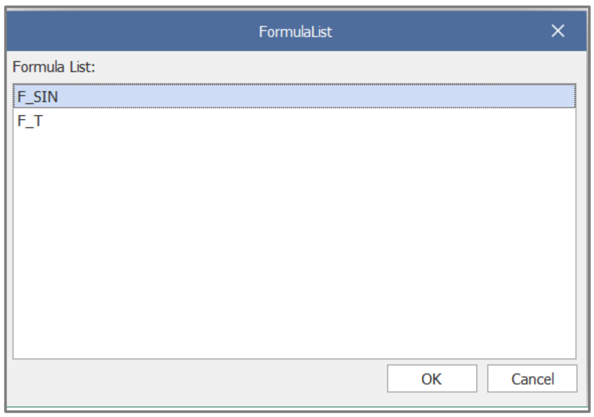


Figure 6-107 The General Formula List Interface

6.6.3 Add and Manage Advanced Formulas

In the Advance Formula area, you can create a new Advanced Formula with a prefix of "AF_." The maximum number of Advanced Formulas is 16.

Open the Advanced Formula Interface

1) From the Formula Interface, click the Advance Formula section, and the buttons in the toolbox will switch to the Advanced Formula Edit Mode.
2) The first four buttons on the Advanced Formula Interface toolbar are the options:
   a) Import Advance Formula – Import an Advanced Formula from another Schedule File.
   b) Add Advance Formula – Add a new Advanced Formula in the last row of the list.
   c) Insert Advance Formula – Insert a new Advanced Formula before the selected Formula.
   d) Remove – Delete the selected Advanced Formula(s).

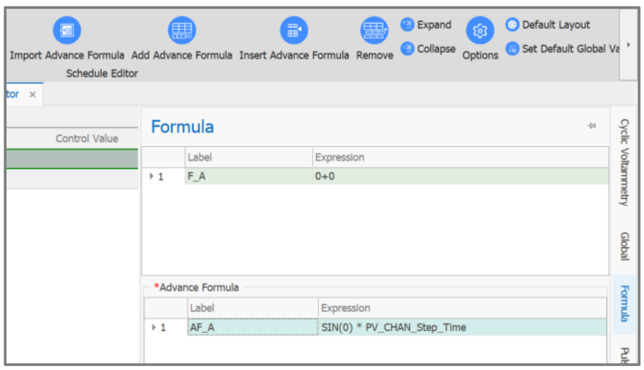


Figure 6-108 Toolbar Buttons for Advanced Formulas

3) You can also access the following options by right-clicking in the Advance Formula list space:
   a) Right-click in the blank Formula space:
      i) Insert Advance Formula – Insert a new Advanced Formula before the selected Formula.
      ii) Import Advance Formula – Import Formula from another Schedule File.

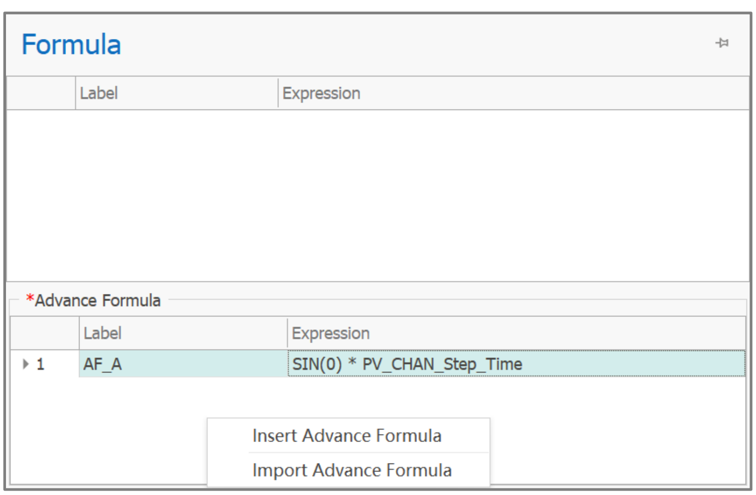


Figure 6-109 Right-Click Menu for the Advanced Formula Space

b) Right-click on an existing Advanced Formula in the Formula space
   i) Insert Advance Formula – Insert a new Advanced Formula before the selected Formula.
   ii) Append Advance Formula – Add a new Advanced Formula to the end of the list.
   iii) Remove Advance Formula – Delete the selected Advanced Formula.
   iv) Copy and Paste – Copy the selected Formula content, which can then be pasted onto an existing Formula to overwrite the original content
   v) Import Advance Formula – Import an Advanced Formula from another Schedule File.

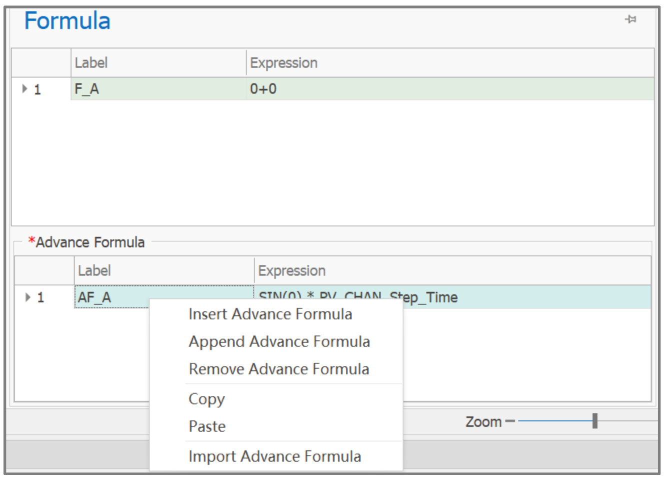


Figure 6-110 Right-Click Menu for the Selected Advanced Formula

Edit an Advanced Formula

1) Click the Expression of an Advanced Formula to open the Advanced Formula Editing Interface.

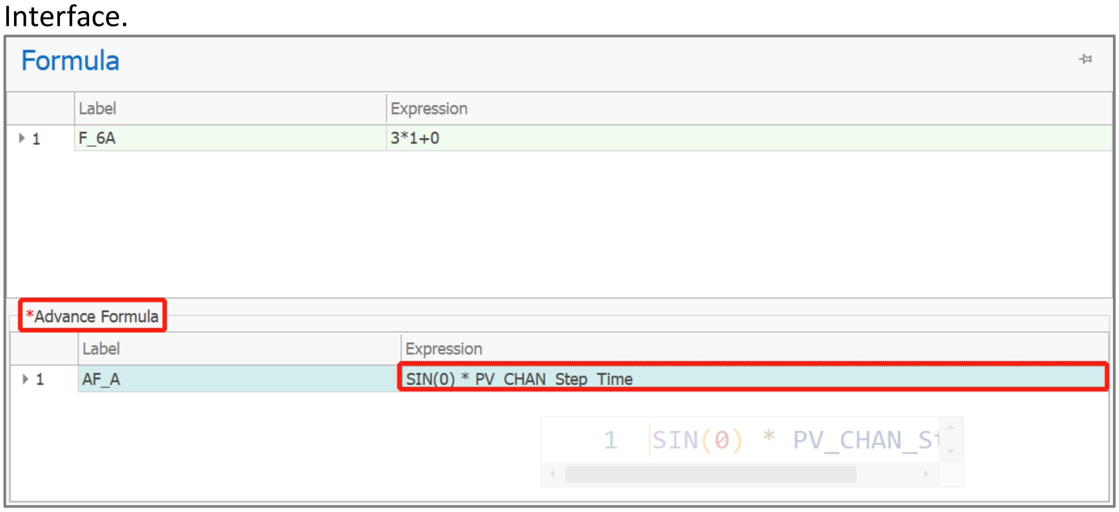


Figure 6-111 Click on the Expression of an Advanced Formula

2) The Advanced Formula Editing Interface can be divided into three areas: Edit area, simplified display area, and check area.
   a) Edit Area – The input box (infix expression) for the Advanced Formula; length of the input field is limited.
   b) Simplified Display Area – Displays the simplified expression if the entered Formula is correct; displays error information if the entered Formula is incorrect.
      i) Errors include invalid characters, parentheses, unsupported functions, variables, etc.
      ii) The user cannot modify content in the Simplified Display Area.
   c) Check Area – List all variables in the advanced Formula. Each variable corresponds to an input edit box.
      i) You can enter the test value in the edit box and click the Test button to calculate the result value of the Formula.

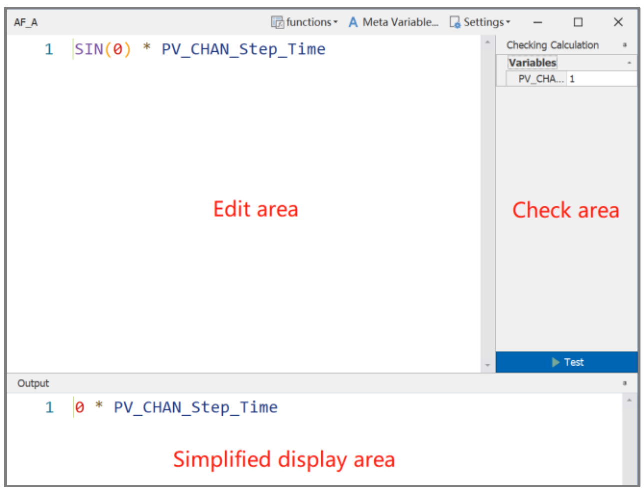


Figure 6-112 The Editing Interface for the Advanced Formulas

3) Use a Function or Metavariable:
   a) Click the "Functions" button on the Editing Interface to see the function description below.

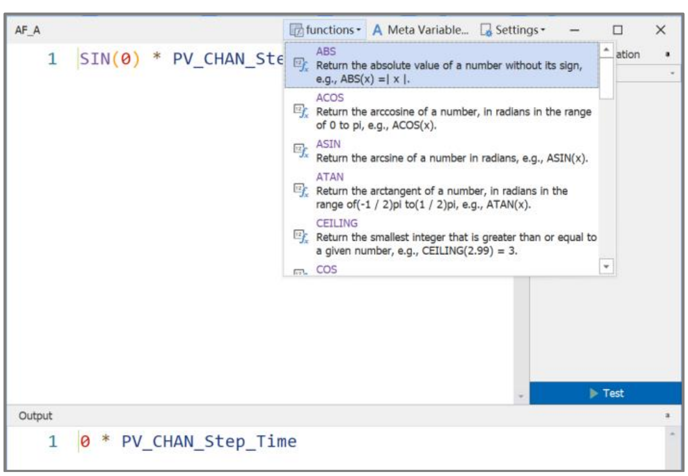


Figure 6-113 Function Options

b) Click the “Meta Variable” button on the Editing Interface to see the variable description from Appendix B.

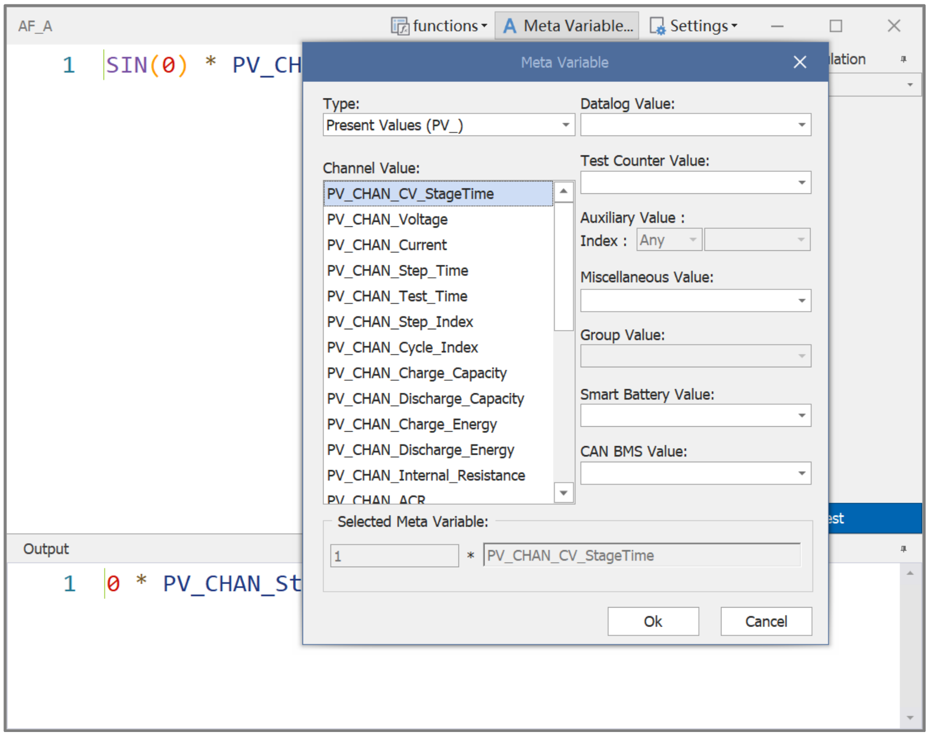


Figure 6-114 Metavariable Options

c) You can also right-click in the editing area to open the Function and Metavariable options and corresponding interfaces.

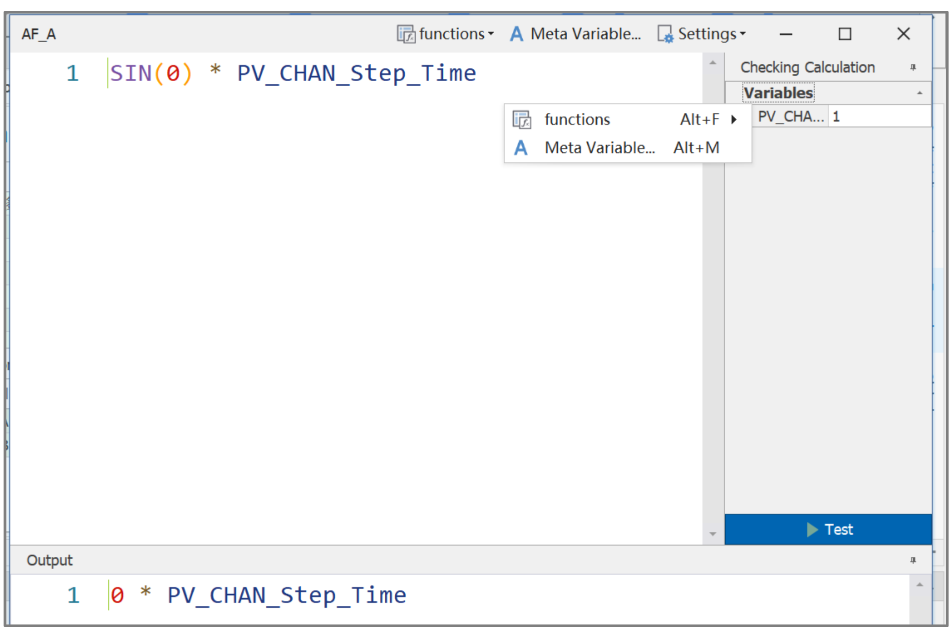


Figure 6-115 Right-Click Menu in the Editing Area

4) Adjust the Formula Interface.
   a) Use the Settings menu option to set colors for formula interface components, including the background numbers, Functions, Variables, Operators, and more.

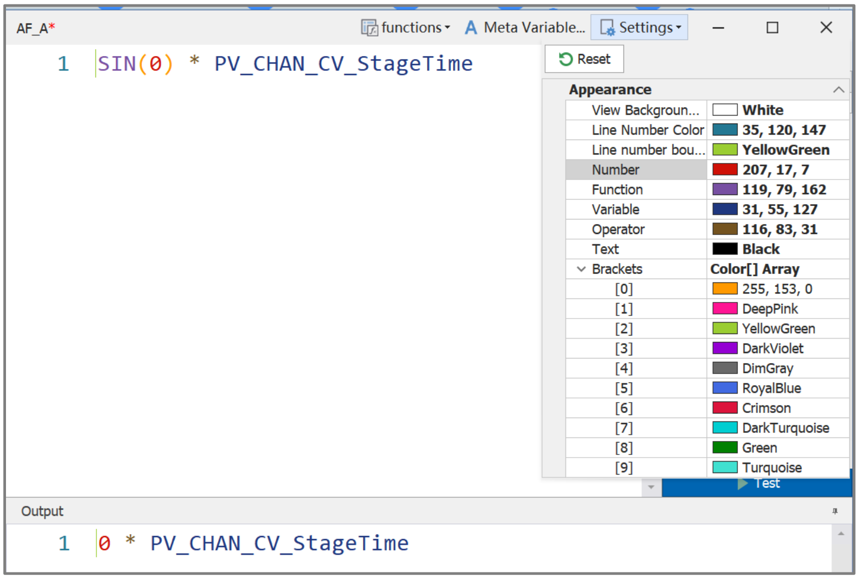


Figure 6-116 Color Setting Options

Use Auto-Suggest in the Advanced Formulas Editing Box

1) After entering English characters, a list of variables matching the entered characters will pop up for the user to choose.

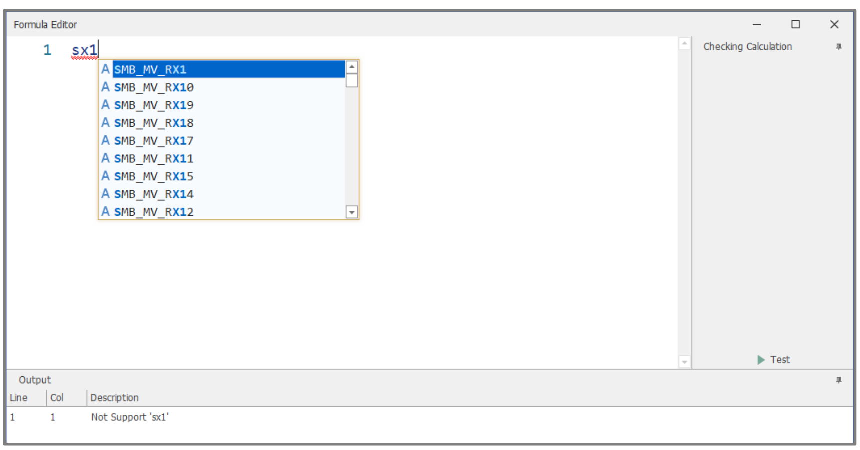


Figure 6-117 The Auto-Suggest for Variable Input

2) Point the cursor at a Function to display the Function meaning.

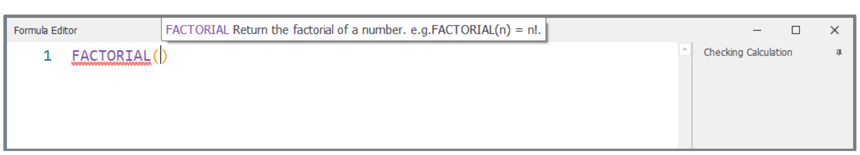


Figure 6-118 The Intelligent Indication for Function Input

3) Prompt validity or error of the Formula in the form of a bubble.

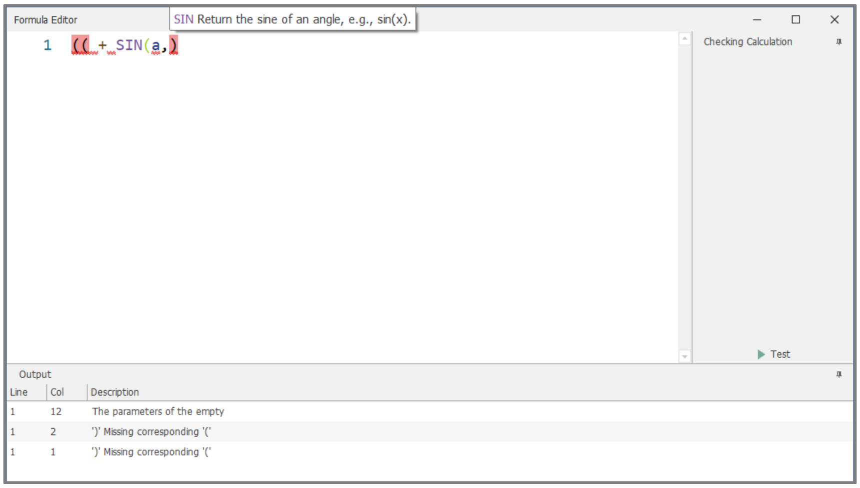


Figure 6-119 Prompt Validity or Error of the Formula in the Form of a Bubble

Invoke an Advanced Formulas in a Schedule

1) Right-click the Control Value or Limit Edit box to open the pop-up menu.

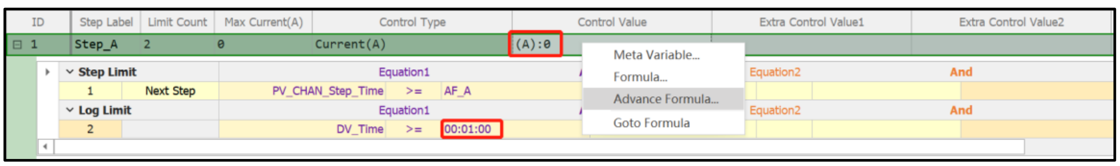


Figure 6-120 Invoke an Advanced Formula in a Step

2) Click the Advance Formula option to open the Advanced Formula List Interface.
3) Click on an Advance Formula from the list to select it.
4) Click the “OK” button at the bottom of the Advanced Formula List Interface.

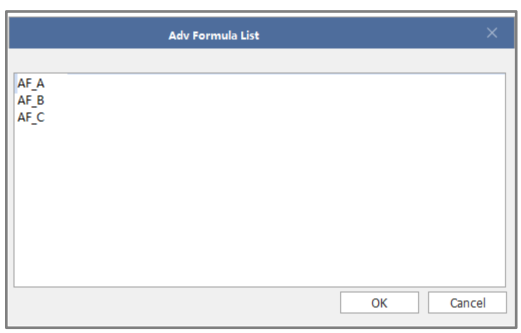


Figure 6-121 List of Advanced Formulas

6.7 Program Pulse Control

6.7.1 Introduction to Pulse Control

Mits X can control part of the Arbin battery test equipment with a pulse function, and output pulse in a regular schedule. Each Schedule can have up to 20 pulses. For model HS21044, the pulse width can be defined as a minimum of 100 us.

NOTE: The execution of this fast pulse may require specific hardware designed for GSM and other high-speed pulses. You can consult the Arbin production department for detailed information on your specific test equipment.

On machines with the Pulse Control function enabled, a Pulse Page will be added to the Schedule Editor for pulse definition. If the system requires Pulse Control, check the Pulse Control option box on the Advance Feature Page of Advance System Config. When you open a Schedule File, an editable Pulse Page will appear in the Schedule File Interface.

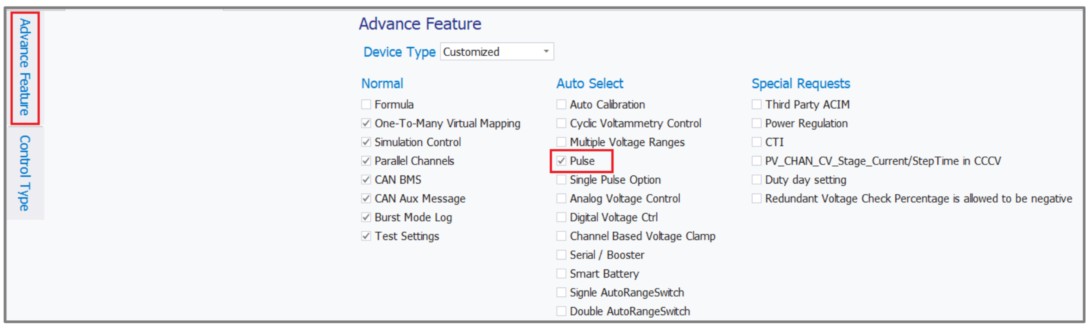


Figure 6-122 Enable Pulse Function on the Advance Feature Page

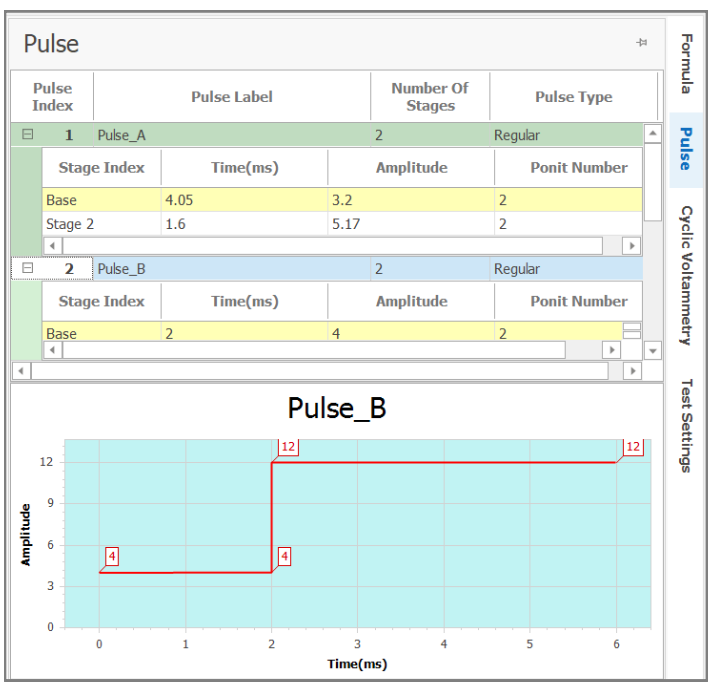


Figure 6-123 The Pulse Page of the Schedule Editor Interface

Pulse Page Field Descriptions

Pulse Field Name	Pulse Field Description
Pulse Index	The serial number of the Pulse.
Pulse Label	Name of the Pulse file. The user can use the default name or rename the Pulse File by double-clicking the cell under Pulse Label and entering a new name.
Number of Stages	Automatically display several stages in the Pulse Profile. This field is not editable.
Pulse Type	This field specifies the general Pulse Type. Options include “Normal” (multi-level waveforms that can be fully defined by the user), “GSM,” “CDMA,” and CDMA2” (all industry-standard waveforms).
Stage Index	Automatically generate Pulse Step number. This field is not editable.
Base	The first stage of each Pulse configuration is defined as the Base Stage.
Stage x	The user can add more stages (at least 1 stage) to the Pulse Profile. The maximum number of stages is 30.
Time(s)	Used to define the time width of the stage.
Amplitude	Used to define the Pulse output amplitude. For current Pulses, the unit is A.

NOTE: To Schedules with Pulse, when the Log Type is DV_PulseCycle, it needs to be greater than or equal to 2. When the Log Type is DV_Time, it needs to be greater than or equal to the whole Pulse Cycle Time m_fMilliSeconds*2.

6.7.2 Precautions for Pulse Control

Both single-channel and multi-channel units can run Pulse steps.

Precautions for Single-Channel Pulse Operation

1) Minimum Pulse Width – According to different equipment types, the Minimum Pulse Width supported by the Pulse is different. Currently, only HS21055 supports a Minimum Pulse Width of 100 us, and other machines only support a Minimum Pulse Width of 550 us.
2) Maximum Pulse Width – It is recommended to keep it below 1 s (not strictly enforced for the time being).
3) Output Current – It is recommended to output only a single polarization current for the same Pulse Profile.
4) The position of the first point is not accurate; it is related to the rising edge of the current. Generally, this situation occurs when using a high range to output a small current.
5) Pulse does not apply to parallel connection mode.

Precautions for Multi-Channel Pulse Operation

1) All the precautions for single-channel Pulse still apply.
2) Basic Principle: Only one normalized Pulse Profile can exist in the same time period. That is, in the same time period, multiple channels can run different Pulse Profiles, but the number of Pulse steps of the Pulse Profiles of these channels and the Pulse Width of each step must be consistent. The output current can be different.
3) In the same experiment, if multiple channels are performing Pulse step experiments at the same time, please ensure that the number of Pulse steps and the Pulse Width in each Pulse Profile is the same. Otherwise, due to the above Basic Principle, it is very likely after multiple cycles some channels will stop due to the Pulse Profile waiting timeout.
4) In the same experiment, if multiple channels are running Tests at the same time, and it is possible to execute the Pulse and IR step at the same time, you need to set the Pulse Width of the IR step to be greater than 50ms. Otherwise, due to the above Basic Principle, it is very likely that some channels will stop due to the IR step waiting timeout after multiple cycles.

NOTE 1: Pulse Profile Waiting Timeout: The timeout period is 10 s. According to the description in 2, when a Pulse Profile A is being executed and a completely different Pulse Profile B is also attempting to execute, the Pulse Profile B needs to wait for the execution of Pulse Profile A to finish before it can start execution. If the timeout period is exceeded, the channel calling Pulse Profile B will stop the Test.

NOTE 2: IR Step Waiting Timeout: The timeout period is 10 s. Due to the mechanism conflict, when channel 1 is executing a Pulse step, if channel 2 needs to execute an IR step with a Pulse Width of less than 50ms, it needs to until channel 1 finishes executing the Pulse step. When channel 2 waits more than 10s, channel 2 will stop the Test.

Precautions for Multi-Channel Pulse Operation Between Multiple Units

The channels of each unit are independent of each other and will not cause interference.

6.7.3 Create a Pulse Profile

Create a Pulse Profile

1) Click the Pulse Tab on the right side of the Schedule Editor.

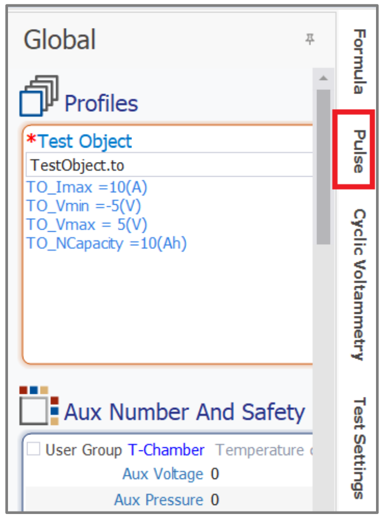


Figure 6-124 The Pulse Tab on the Schedule Editor

2) Add a Pulse in one of the following ways:
   a) From the Pulse Page:
      i) Click the Pulse Tab on the right side of the Schedule Editor.
      ii) Right-click in the margin of the Pulse Page.
      iii) Select the "Append Pulse" option from menu that appears to add a Pulse named Pulse_A and its Base Stage.

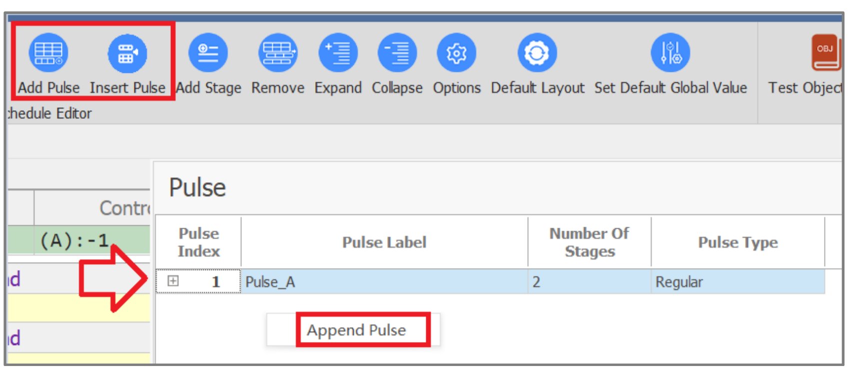


Figure 6-125 Add a Pulse from the Pulse Page

   b) From the Toolbar:
      i) Select an existing Pulse.
      ii) Click on the "Add Pulse" icon on the Toolbar to add a Pulse after Pulse_A.
      iii) Click on the "Insert Pulse" icon to add a Pulse before Pulse_A.

Set Up the Pulse Profile

1) Use the default name or click on the field for Pulse_A and enter a new name for the Pulse.
2) Click “Import Pulse” on the menu bar to import a Pulse.
3) To add more Pulses, double-click the left mouse button on the Index number of a Pulse to add a Pulse below the selected Pulse, or double-click the right mouse button and select the “Append Pulse” option on the menu that appears.
4) Define the Pulse Type as either Regular (user-defined) or Industrial Standard (GSM, CDMA, CDMA2).
   a) If the Industrial Standard Type is selected, Pulse Label, Stage Index, Number of Stages, and Time (ms) will automatically populate.

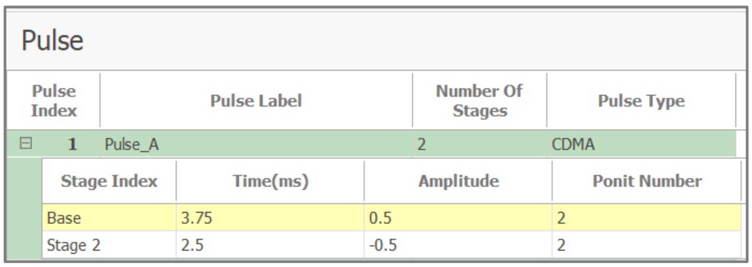


Figure 6-126 Define the Pulse Type

5) Define the Base Stage.
   a) Enter the desired values in the cells under Time and Amplitude.
      i) Amplitude is the output current during the pulse, and can be positive, negative, or 0. Any value within the current or voltage capability of the hardware can be used.
      ii) The Time value of the device can be as small as 100 us.

NOTE: If there is no special hardware support, GSM Pulse and user-defined steps less than 100 us may not be executed. Please refer to the system to determine whether the hardware has Pulse capability.

1) Add Stages in one of three ways:
   a) Select the Pulse of the Stage you want to add, then click “Add Stage” on the Toolbar.
   b) Right-click on the Pulse of the Stage you want to add, then select “Append Stage” from the menu that appears.
   c) Double-click the Index Number under Stage Index to add a Stage.
2) Delete a Stage in one of two ways:
   a) Select the Stage you want to delete and click “Remove” on the Toolbar.
   b) Right-click on the Stage you want to delete, then select Delete Stage from the menu that appears.
3) Define Stage 2.
   a) Enter the desired values in the cells below Time and Amplitude. The range of values that can be entered is limited by the specifications of the hardware.

NOTE: Each Pulse Profile must have at least two stages, the Base Stage and Stage 2.

The preview chart of the Pulse Profile will be displayed at the bottom of the Schedule Editor. When a certain Pulse (such as Pulse B) is selected, the chart will draw a preview of the Pulse B Pulse edited in Schedule.

The graph is drawn as the relationship between amplitude and time (time units include milliseconds and seconds). Log preview is based on Log interval, and you can set the number of Pulse Cycles for preview.

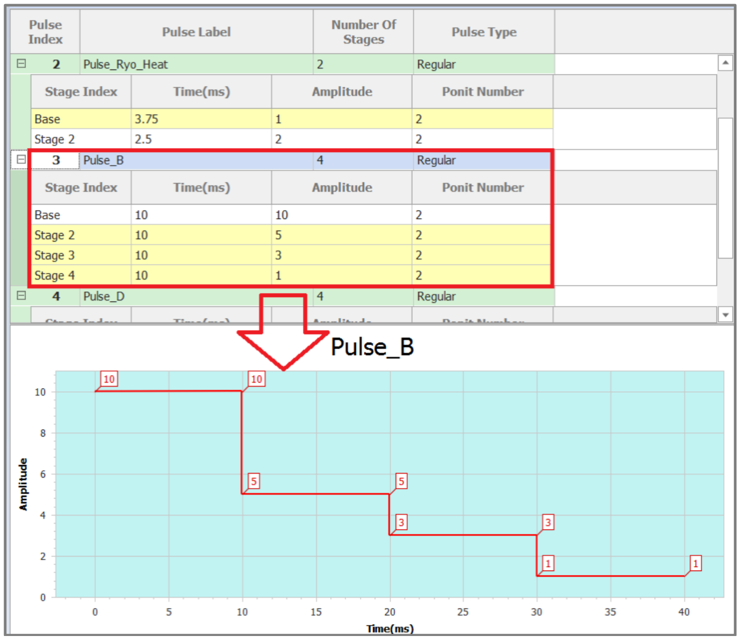


Figure 6-127 Preview of Pulse B

Delete a Pulse Profile

You can delete a Pulse Profile two ways:

1) Double-click the right mouse button on a Pulse you want to delete and select the “Remove Pulse” option on the menu that appears.
2) Click on the Pulse Profile you want to delete and click on “Remove” on the Toolbar bar. You can also select multiple Pulses to delete at the same time.

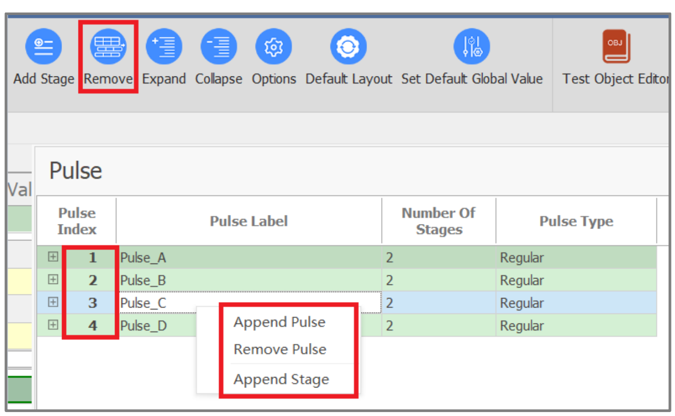


Figure 6-128 Delete a Pulse Profile

6.7.4 Create Pulse Control Steps

1) Follow the steps above to create the Pulse Profile on the Pulse Page.
2) Select “Current Pulse(A)” as the Control Type.
3) Click the cell under Extended Definition.
4) Select the desired Pulse Profile from the drop-down box. (You must create the Pulse Profile before it can be selected from this menu.)

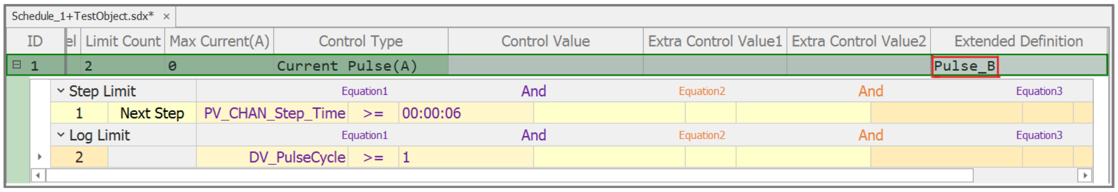


Figure 6-129 Select the Pulse Profile

5) Set the value of the Max Current (A).
   a) Mits X automatically switches the current range according to the maximum current. In order to obtain the best Test results, it is very important to input the appropriate maximum current value.
   b) Select the appropriate maximum current value according to the amplitude of the Pulse waveform. Refer to the rated value marked on the front of the test equipment, as this varies between different test equipment.
   c) A Pulse can only be executed within a current range, even if contains several different amplitude steps. For multi-level current pulses, compare the highest amplitude value with the hardware current range setting and enter the appropriate Max Current (A).

NOTE: Please do not set any “logical AND” limit conditions in the Pulse step. In addition, Log Limit can only use two meta variables (DV_Time and DV_PulseCycle) in the Pulse step.

6.8 Program Cyclic Voltammetry

6.8.1 Introduction to Cyclic Voltammetry

Cyclic Voltammetry is an electrochemical analysis method. Traditional Cyclic Voltammetry is used to apply a bidirectional linear voltage ramp between the sample electrodes to identify and characterize specific electrochemical processes.

Mits X can achieve this kind of test by using voltage ramp steps (one forward and one reverse). The Cyclic Voltammetry Control Type allows users to control the experiment in a way that is more in line with the analog instrument. In addition, using the same parameters, a bidirectional current sweep (specified as the current period) can also be applied. (Note: The reference behind the Cyclic Voltammetry refers to the control type, not the strict definition of the analysis technique.)

The following Figure shows the Cyclic Voltammetry Page of the Schedule File.

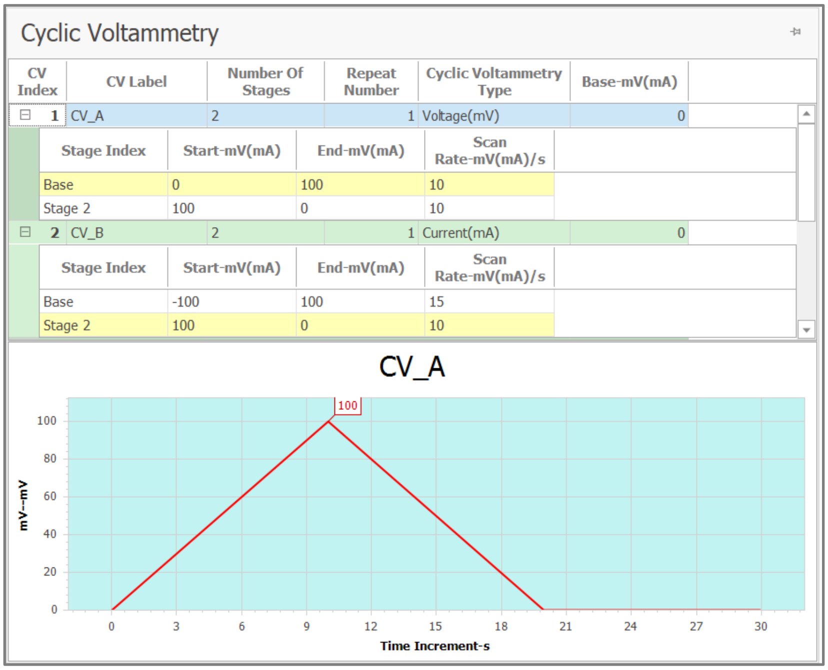


Figure 6-130 The Cyclic Voltammetry Page

If the system needs the Cyclic Voltammetry Control function, first check the Cyclic Voltammetry function on the Advance Feature tab of Advance System Config as shown in Figure 6-29, then the Cyclic Voltammetry Page will be displayed. If this option is not selected, the Cyclic Voltammetry Page in the Schedule File will be disabled, and the Cyclic Voltammetry configuration cannot be edited.

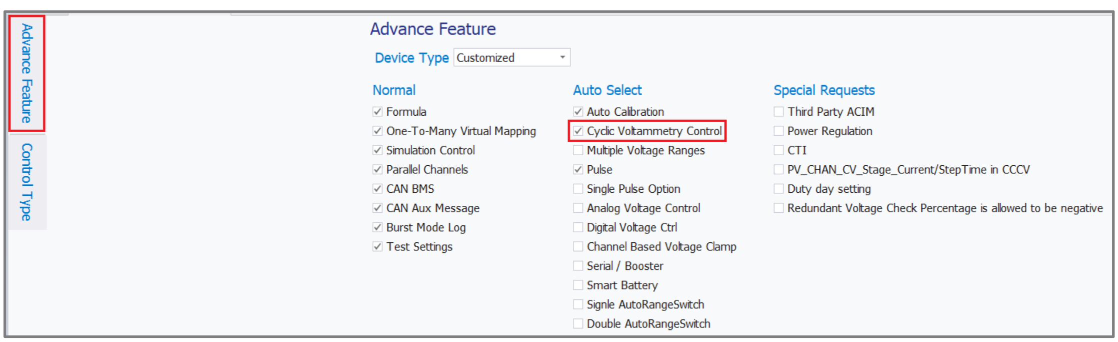


Figure 6-131 Enable Cyclic Voltammetry Control on the Advance Feature Page

Cyclic Voltammetry Page Field Descriptions

NOTE: CV is an abbreviation for Cyclic Voltammetry.

Cyclic Voltammetry Field Name	Cyclic Voltammetry Field Description
CV Index	The numerical index of CV Files created in a single Schedule File. The CV Index starts from 1.
CV Label	User-definable alphanumeric indentifier, referenced in the extended definition on the Step/Limit Page of the Schedule File.
Number of Stages	The total number of stages created in the definition of Cyclic Voltammetry. This field is not editable.
Repeat Number	User-defined input for the number of stages created in the Cyclic Voltammetry phase.
Base-mV (mA)	The value to maintain constant voltage or constant current after the end of the Cyclic Voltammetry scan process.
Cyclic Voltammetry Type	Select the voltage (mV) or current (mA) for this CV from the drop-down list.
Stage Index	Automatic and sequential recognition of Cyclic Voltammetry scan direction.
Start-mV (mA)	The starting value of the Cyclic Voltammetry scan. (Note that the linear sweep related to voltage or current is determined in the Control Type selection.)
End-mV (mA)	The final value of the Cyclic Voltammetry scan.
Scan Rate-mV (mA)/s	The slope of a linear scan (note that the sign is always positive).

6.8.1 Set Cyclic Voltammetry Control

1) Click the Cyclic Voltammetry Tab on the right side of the Schedule Editor.

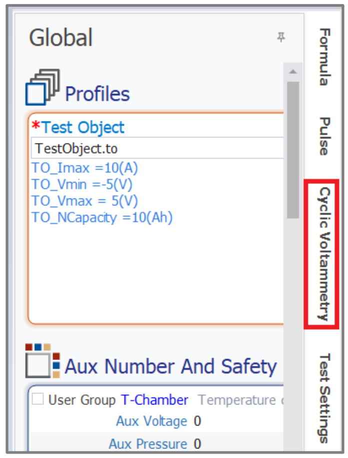


Figure 6-132 The Cyclic Voltammetry Tab in the Schedule Editor

2) Right-click in the blank area of the Cyclic Voltammetry Page and select “Append CV” to add a new CV labeled CV_A. On the Toolbar, click “Add CV” to add a CV after CV_A or click “Insert CV” to add a CV before CV-A.

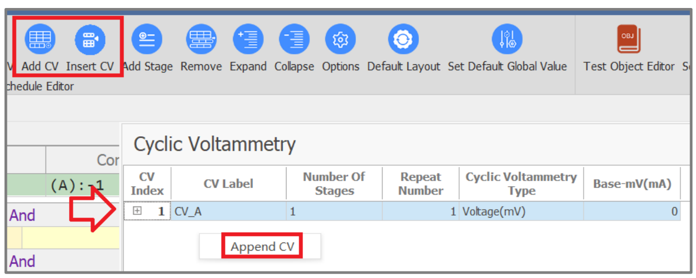


Figure 6-133 Append CV

3) Use the default name or click on the field for CV_A and enter a new name for the CV.
4) Click “Import CV” on the menu bar to import CV.
5) Left-click the index number of the CV to add a CV, or right-click a CV to add or delete a CV. Select the CV you want to delete and click “Remove” on the Toolbar to delete it. You can also select multiple CVs to delete at the same time.

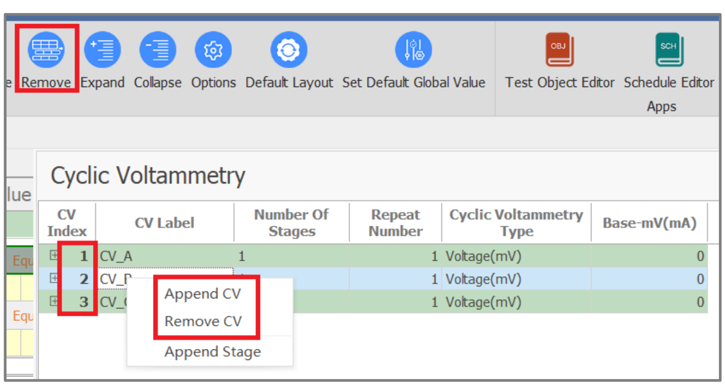


Figure 6-134 Append or Remove CV

6) Define the first step and enter the required values in the Start-mV (mA), End-mV (mA), and Scan Rate-mV (mA)/s fields.
7) Add other stages to the CV definition by right-clicking next to the stage index number or following the instructions in step 2 above.

EXAMPLE: Create a linear voltage scan graph (CV_A), at a rate of 20 mV/s, from 0 to IV from IV to –IV, and then back to 0. Create a linear voltage scan profile (CV_B) from 100 mV to –50 mV at a rate of 30 mV/s, and then from –50 mV to 200 mV at a rate of 20 mV/s. The CV summary chart will display at the bottom of the CV Page in the Schedule File. The user can place the cursor at the CV_A position to highlight the line of CV_A and display the CV_A graph in the Schedule Editor.

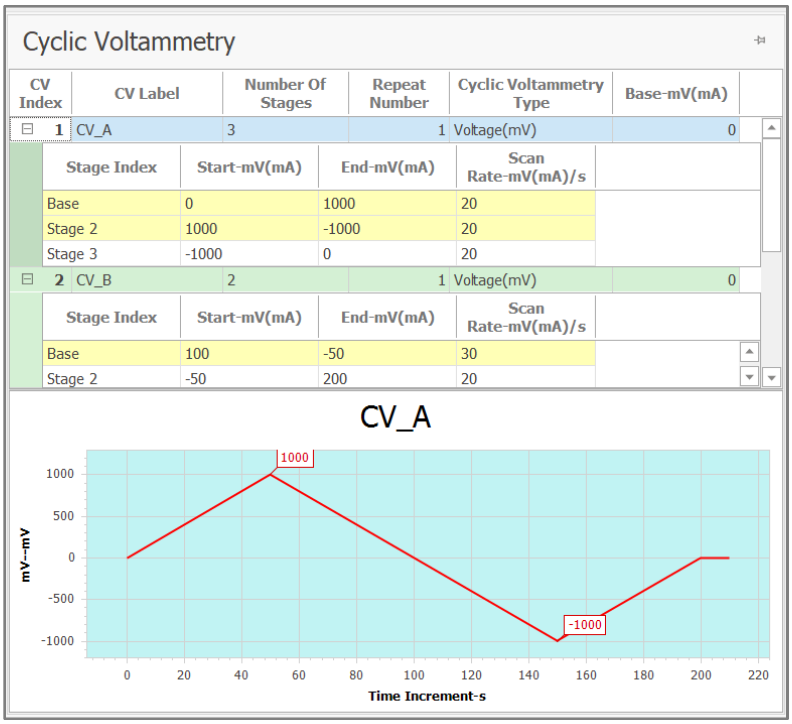


Figure 6-135 CV Summary Chart

The Base-mV (mA) of V_A is filled with 0. This definition will result in a scan where the CV Test ends with a value of 0 mV.

8) In the Schedule Editor, select Voltage CycleV for the Control Type, and select the edited CV Label in the Extended Definition position to call.

In this case, the Schedule will execute the first step CV_A of scanning the Cyclic Voltammetry File with a duration of 200 s. Keep 0 mV in the remaining Step_Time and collect data every 10 seconds.

6.9 Set the Test Settings Control

6.9.1 Introduction to Test Settings

Test Settings is a very important advancement in the pursuit of system integration. With this function, communication with third-party temperature chambers can be realized, and Mits X seamlessly improves the communication function between Arbin's electrochemical test instrument and peripheral hardware. In addition, Mits X can process TTL signals through digital input and digital output functions.

Many of Arbin's advanced features are driven by the application and professional testing requirements that arise in these new implementation areas. The most obvious of these new technologies is Arbin's fuel cell test instrument, FCTS. In this hardware platform, Arbin hardware and software must be connected with new peripheral components, such as valves, sensors, and alarms. To achieve this new level of coordination, Arbin Instruments has expanded its impressive hardware capabilities with new digital input and output routing circuits.

Mits X supplements new auxiliary hardware by including new test setup element types and new auxiliary values (see **Appendix B: Auxiliary Measurement-Related Parameter**). It also provides detailed information about the configuration of a system equipped with digital hardware.

The "Test Settings" function can be enabled by selecting the "Test Settings" option under "Advanced Features" in the system configuration file Advance System Config. If this option is not selected, the "Test Settings" page in the Schedule will be disabled, and temperature control cannot be implemented.

Usually, there is another option to check, namely "One-to-Many Virtual Mapping" (one-to-many virtual mapping) for the temperature chamber control. Special hardware is required to execute the "Test Settings" function.

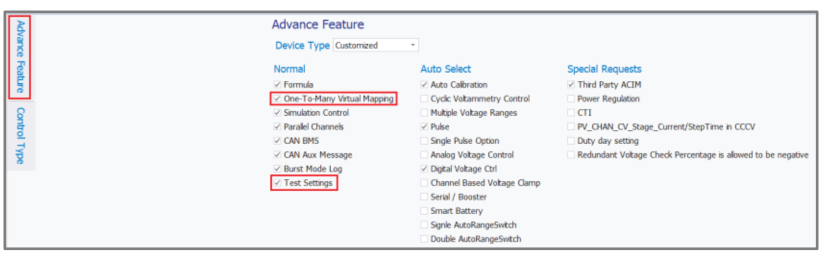


Figure 6-136 Enable Test Settings on the Advance Feature Page

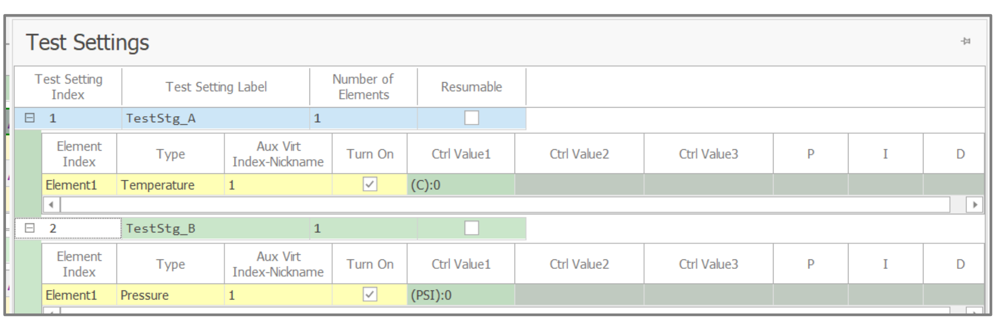


Figure 6-137 Test Settings Configuration

Test Settings Field Descriptions

Test Settings Field Name	Test Settings Field Description
Test Setting Index	The numerical index of the Test Settings created in the Schedule File.
Test Setting Label	User-defined alphanumeric identifier, referenced in the "Test Setting" column of the Step/Limit Page of the Schedule File.
Number of Elements	The total number of control elements created in the Test Setting definition This field is not editable. **NOTE:** Multiple elements must refer to different auxiliary indexes.
Element Index	The serial number of the control element.
Type	To select the type of control to be executed through Test Setting: temperature, flow rate, digital output, or pressure. **NOTE:** Flow rate and pressure are only applicable to the fuel cell test system.
Aux Virt Index-Nickname	The auxiliary virtual channel to be controlled, the index of the Auxiliary Channel in the batch file is selected.
Turn On	Turn on the element.
Crtl Value 1	Control value.
Crtl Value 2	This value applies to AO control. There are two types of control: close loop control and open loop control (closed loop control and open loop control). For closed- loop control, an analog input channel is required for feedback.
Ctrl Value 3	Theis value applies to AO controls. When Ctrl Value 2 is set to closed-loop control, Ctrl Value 3 is activated.
P, I, D	These values will be used for PID control of the output (AO) signal.

6.9.2 Create Test Settings

As we mentioned in the introduction above, Test Settings can affect two types of control and signal processing: Thermal Control and Digital Signal Processing.

Although both are implemented within the scope of the above functional elements, some parameters are specific to one type. Therefore, we solve these two modes separately below.

Thermal Control

The thermal control aspect of the Test Settings function performs two functions:

2) Set a third-party temperature box.
3) Determine the correspondence between the main IV channel and the operation of the temperature box.

The following schedule page identifies the parameters that must be defined in order to implement functions 1 and 2. See above Field Descriptions of Test Settings Page for more information.

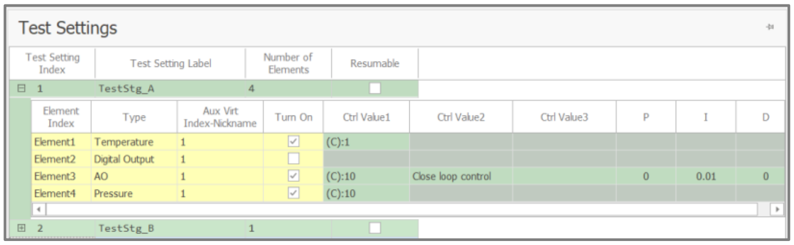


Figure 6-138 Test Setting Page of the Schedule File

Software Configuration

For hardware types-PMTC or third-party temperature controllers, there are some software settings that must be checked before operation. These settings are located in multiple pages of the system configuration file config.

Please note that the system configuration file contains all information about system composition and calibration. This file should be pre-configured from the factory and need not be modified. Before modifying any parameters, please contact Arbin Customer Support and back up the files to an alternate location.

1) Ensure that the system is configured to accept additional temperature channels. In this example, the two auxiliary temperature channels correspond to the temperature of each of the two temperature control chambers.
2) Mark the relevant channel as a controllable channel so that the integrated microcontroller can actively adjust the temperature control chamber.

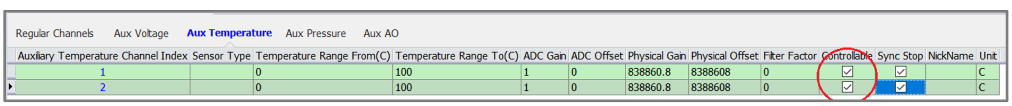


Figure 6-139 Controllable Channel Setting

3) Map the temperature control chamber to the main IV channel through Mapping. For more information on editing the Auxiliary Channel Mapping, see **7: Mapping Files**.

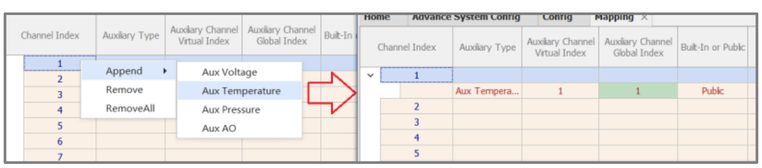


Figure 6-140 Test Setting Page of the Schedule File

4) Save and close the Mapping Configuration.

Test Settings

1) Click the Test Settings Tab on the right side of the Schedule Editor.

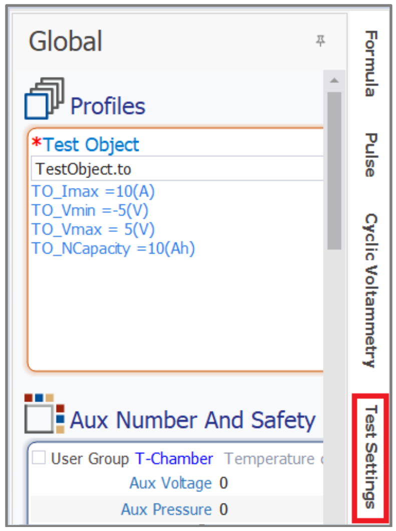


Figure 6-141 Test Setting Tab of the Schedule File

2) Right-click on the blank area of the Test Settings Page and select “Append TestSetting” to create a Test Setting with a single default element. The default parameters assume that a device is placed in a separate temperature control chamber, represented by Aux Index (for the main IV channel data and auxiliary data, please refer to **15: Auxiliary Management System Function**). The temperature control chamber will remain at a given temperature (Value).

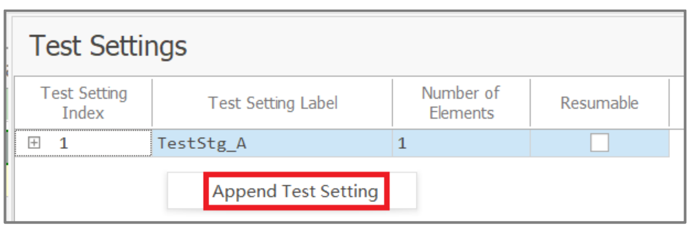


Figure 6-142 Append Test Setting

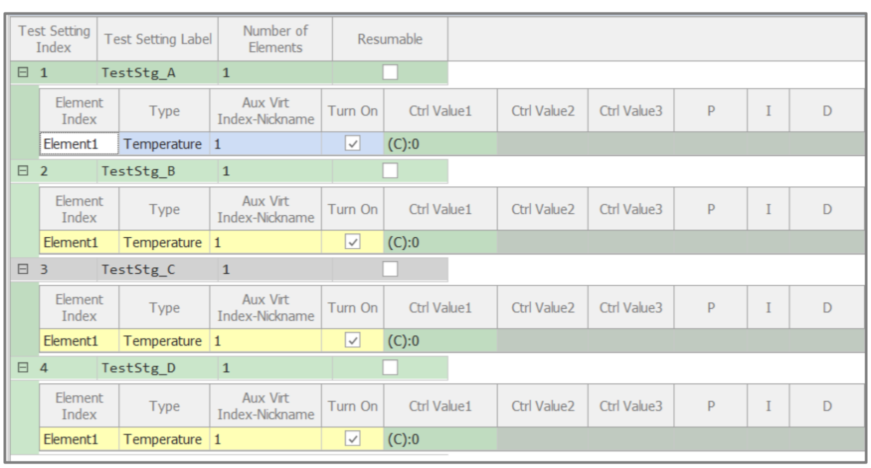


Figure 6-143 Test Settings with Default Settings

3) Use the default name or click on the field for field containing “TestStg_A” and enter a new name for the CV.
4) On the Toolbar, click “Import Test Setting” to import a Test Setting.
5) On the Toolbar, click the “Add Test Setting” icon to add a Test Setting after the currently selected Test Setting or click the “Insert Test Setting” icon to add a Test Setting before the currently selected Test Setting.
    a) You can also double-click the Index number of the Test Setting to add a Test Setting after the currently selected Test Setting, or right-click on Test Setting to choose to add or delete the Test Setting.
    b) Or select the Test Setting you want to delete, click the “Remove” icon on the menu bar. You can also select multiple Test Settings to delete at the same time.

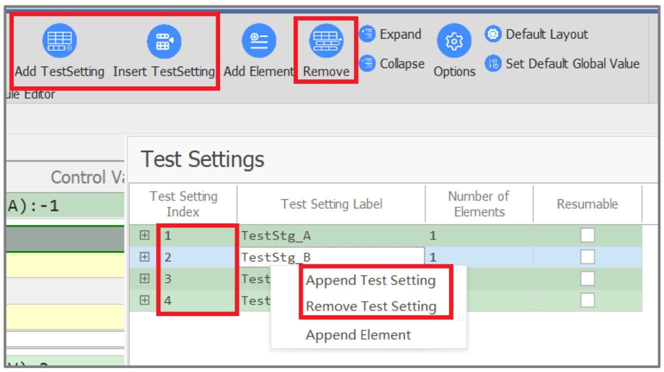


Figure 6-144 Append and Remove Test Settings

6) Select the parameters according to the above description to modify the Test Setting. The following examples show several different Test Setting uses.

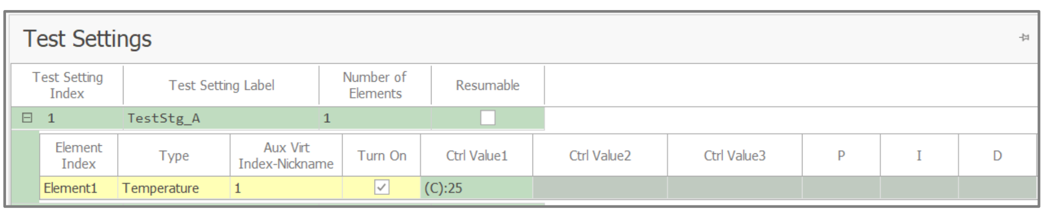


Figure 6-145 25°C Test Setting Definition

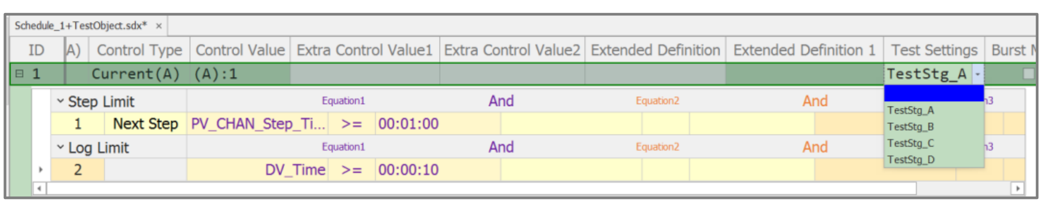


Figure 6-146 Schedule References Test Settings

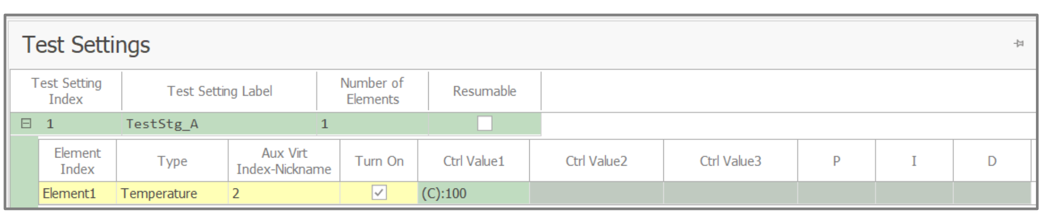


Figure 6-147 100°C Test Setting Definition

6.9.3 Use DIDO

1) Confirm in the System Configuration File that the digital input and digital output channels are enabled.

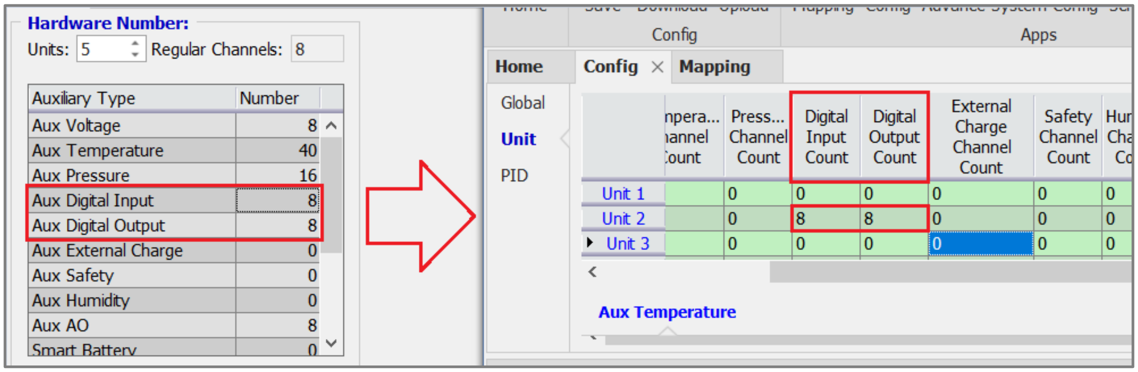


Figure 6-148 Virtual Digital Input and Output Specified in the System Configuration File

2) In the Mapping File, map one or more digital channels to the main IV channel. (For instructions on associating main IV channel data and auxiliary data, please refer to **Chapter 15: Auxiliary Management System Function**).
3) To modify the parameters, first select the digital output as the Element Type. The two operations proposed here are:
   a) By opening the purge gas solenoid valve.
   b) By starting the Test.
4) Process the sensor alarm signal and then shut down the system when the alarm is activated.
   a) The fuel cell test can be started by adjusting the value of the purge gas line to eliminate the residual reaction gas from the feed line. This initialization can be done in the following way:

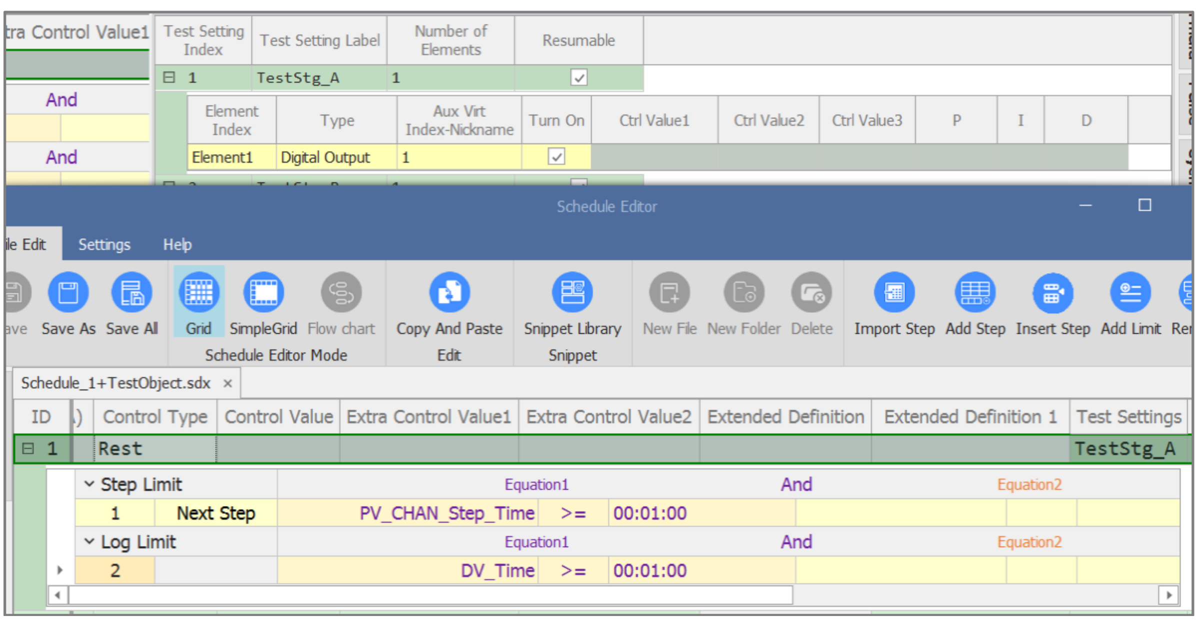


Figure 6-149 Use the Test Setting and Schedule Call to Clear the Startup Test

This Element1 means that the digital output 1 will send an "on" signal to the related equipment to open the blow valve.

NOTE: Users should remember that Test Setting Elements are still valid before encountering a new Test Setting. Therefore, in order to terminate this initial cleanup step, the user will be required to create a subsequent Test Setting, in which the Turn On option is deselected.

b) The second case is a little more complicated and needs to be able to sense the input TTL signal and perform subsequent operations. In this mode, the digital circuit acts as a signal processing program, responds to the digital input, and, in this case, generates the appropriate digital signal to the combustible gas alarm siren.

   i) As with the temperature-based Test Settings and the previous Digital Output example, the first requirement is to map the auxiliary channel to one or more main IV channels. Since a typical FCTS chassis only accommodates one channel, users can choose to use the auxiliary mapping wizard (**see 7.2**) to create one-to-many mapping. However, in this case, we map a digital input and an additional output channel to the main IV channel. Please note that the Virtual Channel does not need to match the Physical Channel.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public
1				
	Aux Digital Input	1	3	Public
	Aux Digital Output	1	1	Public
	Aux Digital Output	2	3	Public

Figure 6-150 Mapping

   ii) Create a Test Setting to generate appropriate TTL "high" signal (select Turn On).

Test Settings

Test Setting Index	Test Setting Label	Number of Elements	Resumable
1	TestStg_A	1	✓

Element Index	Type	Aux Virt Index-Nickname	Turn On	Ctrl Value1	Ctrl Value2	Ctrl Value3	P	I	D
Element1	Digital Output	2	✓						

Figure 6-151 Auxiliary Channel Virtual Index 2 is Set to Connect the Alarm

Please note that we use the second output signal (Aux Index 2) to connect the alarm.

iii) Create a Schedule Table to associate the required responses.

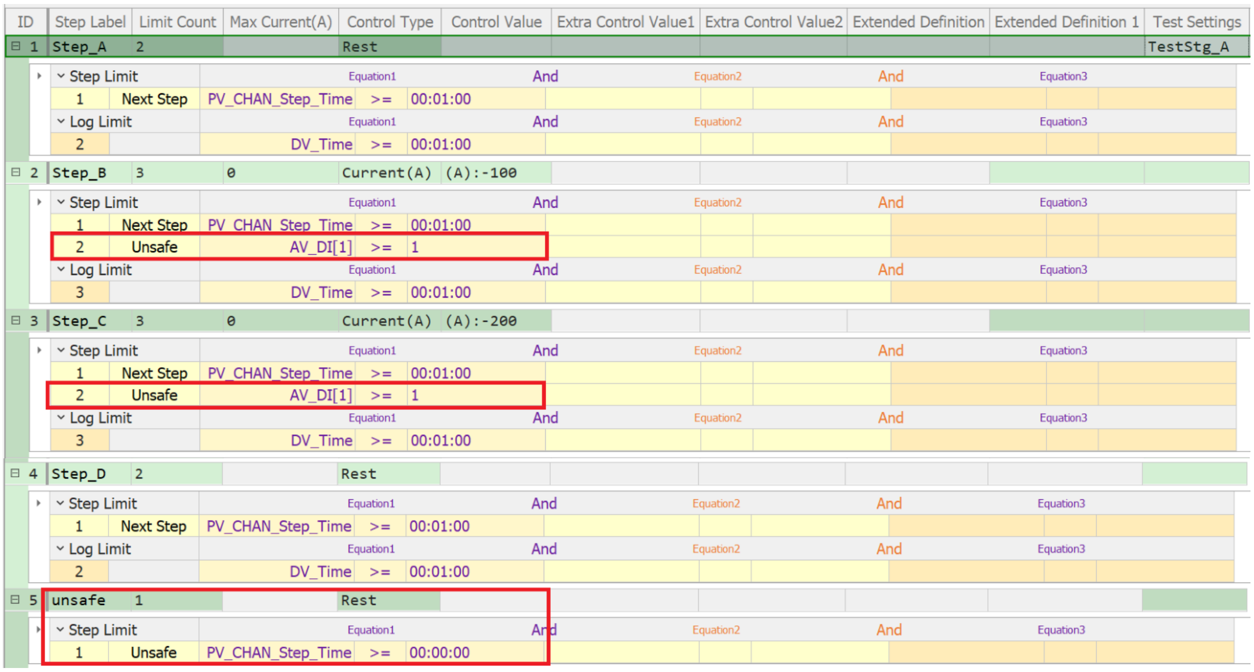


Figure 6-152 Siren Alarm is Associated with TestStg-A

In this example, the tester will discharge the battery stack with two different currents. Please note that in Limit 2 of Steps 2 an 3, the value of Aux Digital Input Index 1 is monitored.

If at any time during the discharge the gas sensor detects combustible gas above the threshold level, it will generate a high (=1) signal, which will trigger the DI channel and cause the Step to jump to Step 5 (“alarm”). At this time, the previous Test Setting (TestStg_A) is activated, causing the alarm to be triggered, and the channel immediately reports “Unsafe Status” in the Monitor and Control Interface.

6.9.3 Bind Test Setting to Schedule Step

As mentioned above, Test Settings are bound to the Schedule by reference in the “Test Setting” field of the Step.

6.10 Measure DC Internal Resistance

In Mits X, measuring the internal resistance (IR) of a battery or the equivalent series resistance (ESR) of a capacitor is a standard feature. IR or ESR measurement can be integrated in a Test, and charge and discharge cycles, capacity calculations, and other MITS standard control types can be performed in a measurement.

6.10.1 Previous Method of Measuring Internal Resistance

When the current amplitude is set to IIR, the Pulse Current changes between I0-IIR and I0 + IIR. I0 is the offset of the current, that is, the average current during IR measurement. In this IR test method, the current values after the data point takes time T1 are P2 and P3, as shown in the figure below. IR data is the average of 10 pulses.

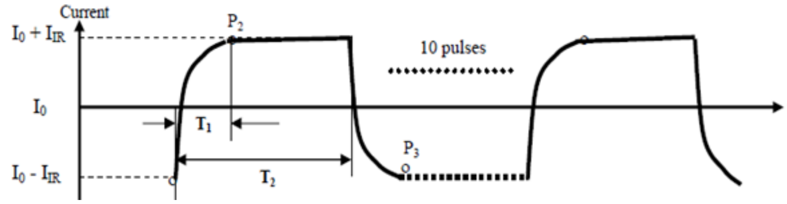


Figure 6-153 Pulse Pattern for IR Measurement

IR Calculation Formula:

$$\mathbf{IR = Average\ \{(Voltage\ at\ P_2 - Voltage\ at\ P_3) / (2\ I_{IR})\}.}$$

In the method, the pulse width of the internal resistance pulse is T2, and the data sampling time is T1.

The IR Pulse Time is 50 ms to 2 ms. The width of each pulse cannot be fixed in advance and depends on the configuration of the test system and the total test load on the system. The time of T2 is equal to five to six times T1.

IR measurement for 10 pulses requires 20 times the time of T2, plus the non-pulse time of 55 ~ 60ms before the 10 pulses and the non-pulse time of 60 ~ 65ms after the 10 pulses, so the total duration of one ESR measurement is 20×T2+12520×T2+125 ms.

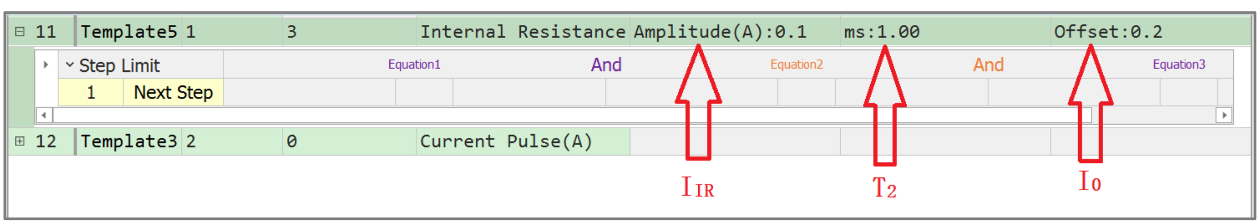


Figure 6-154 Parameters in the Measurement Table

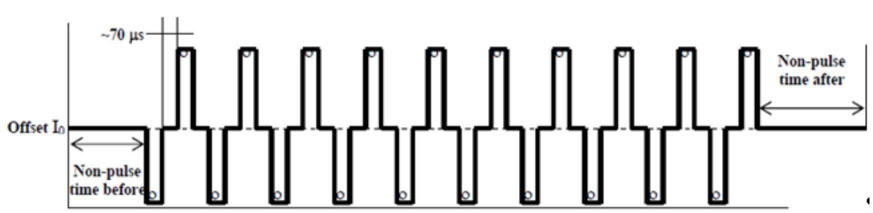


Figure 6-155 Time Base of Each IR Measurement

6.10.2 Measure Internal Resistance with Mits X

In order to measure IR more accurately and reduce the interference of electrochemistry and concentration polarization as much as possible, the improved model still generates 10 pulses. In the improved IR test method, the data points are taken at P2 at the end of T1 and at P3 just before the current rise, as shown in the figure below, intercepting an average of more than 10 pulses.

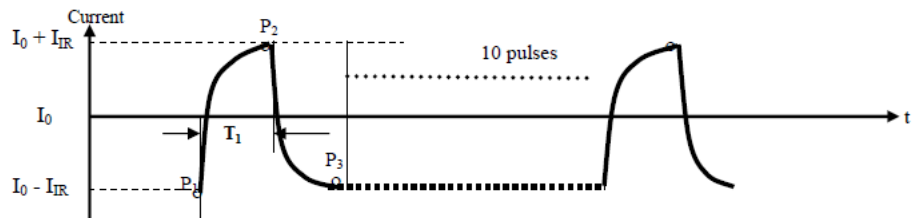


Figure 6-156 Improved IR Measurement Pulse Model

The formula for calculating IR is the same:

IR = Average {(Voltage at P2 – Voltage at P3) / 2 (IIR)}.

T1 is the IR pulse width or data sampling time.

In this improved method, T1 = T2. The data sampling time is equal to the pulse width. The adjustable time of T1 is 1ms to 1000ms. The rest of the IR measurement settings are the same as the previous method.

7: Mapping Files

7.1 Introduction to Mapping Files

7.1.1 What is Mapping?

The Mapping File is a directory that assigns Test Schedules to specific channels. With Mapping Files, users can organize Test Schedules that will be executed in collaboration with each other. In particular, the Mapping File enables users to:

1) Operate a group of channels in parallel.
2) Map an auxiliary measurement (for example, auxiliary voltage, temperature, pressure, and pH) channel to a main IV channel.
3) Map SMB and CAN channels to a main IV channel.

The user can create only create the Mapping File “ArbinSys.bth,” which is a file actively used during the Test. Any subsequent test environment must be started as ArbinSys.bth, thereby overwriting the previous content of the system Mapping File. ArbinSys.bth can only be edited when the channel is not running a Test.

Open the Mapping Editor

1) Double-click the “Mapping” icon in Mits X to open the Mapping Editor.
2) In the Mapping Editor, you can associate the auxiliary input channel with the main IV control channel.

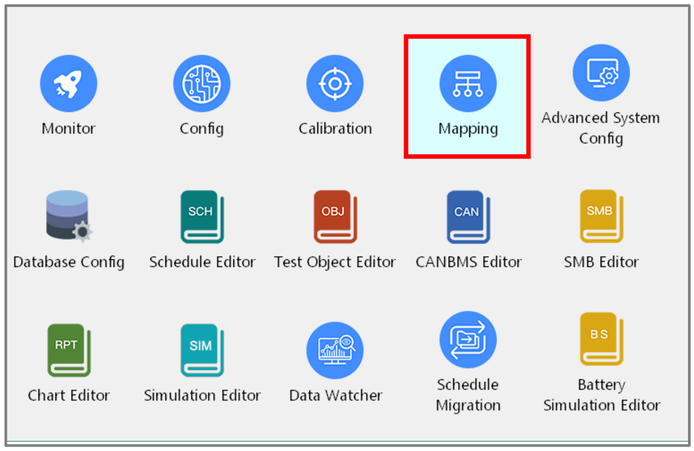


Figure 7-1 The Mapping Editor Icon

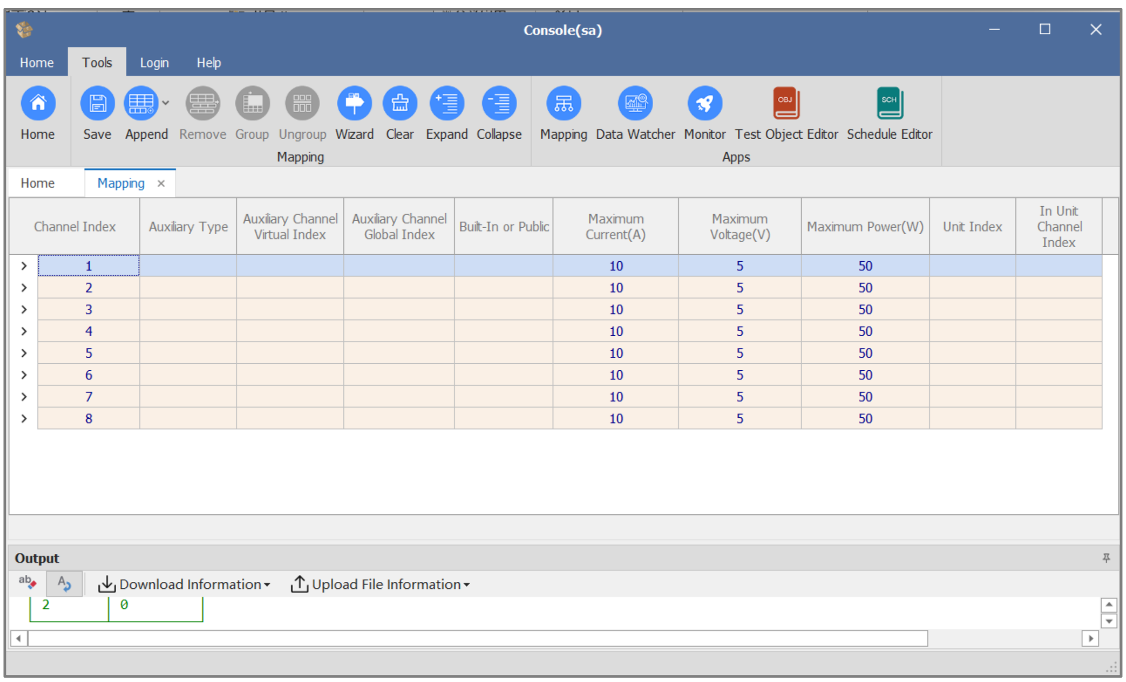


Figure 7-2 The Mapping Editor

7.1.2 The Mapping Toolbar

The Mapping Toolbar provides several key functions for editing Mapping Files, which are explained below.

Figure 7-3 The Mapping Toolbar

Save

After changes are made to the Mapping File, the Mapping File must be saved for the changes to take effect.

1) Click on the "Save" icon in the Mapping Toolbar.
2) Click "OK" in the pop-up box that appears.

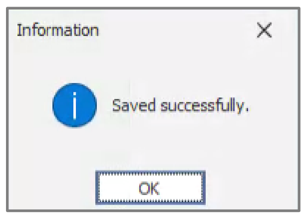


Figure 7-4 The Mapping Changes Saved Successfully

Add Auxiliary Channel

Add Auxiliary Channel allows you to map the auxiliary channel to the IV channel.

1) Left-click on the IV channel you want to Map to select it.
2) Click on the "Append" icon in the Mapping Toolbar.
3) Select the auxiliary channel type that you want to add.

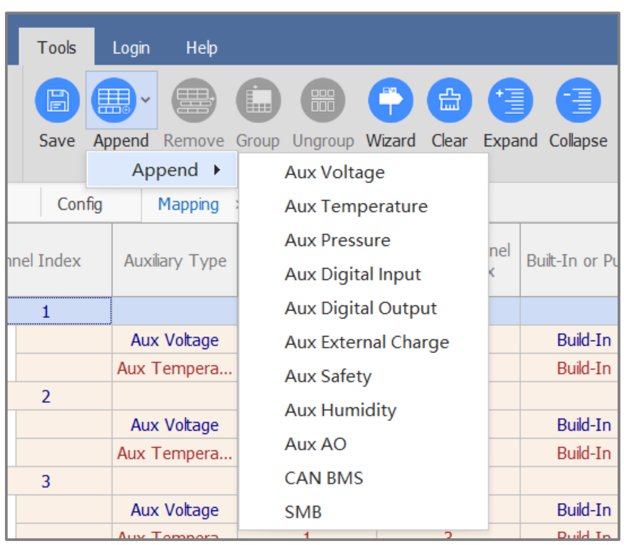


Figure 7-5 Select the Auxiliary Channel

Remove an Auxiliary Channel

Use the "Remove" feature to delete an auxiliary channel.

1) Left-click on the auxiliary channel you want to delete to select it.
2) Click on the "Remove" icon in the Mapping Toolbar.

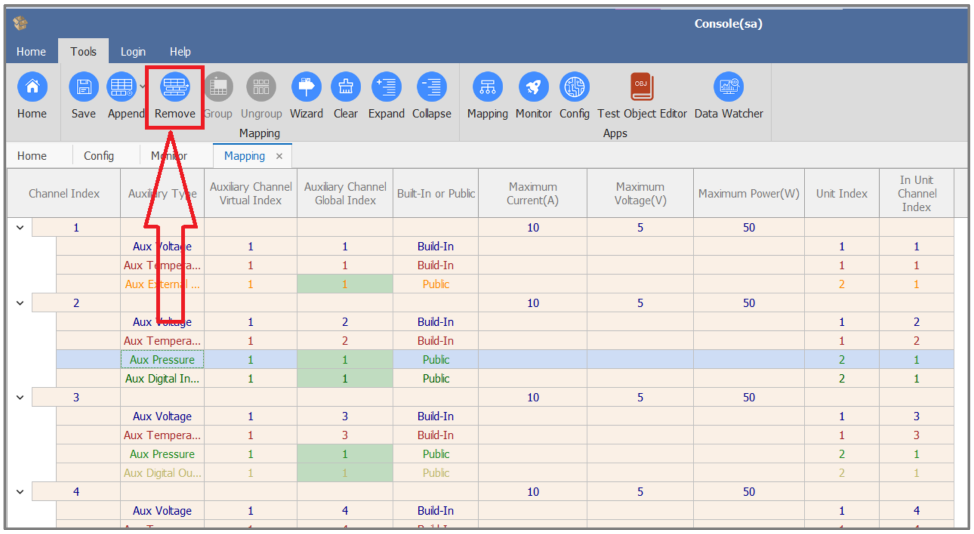


Figure 7-6 Remove an Auxiliary Channel

NOTE: Only the auxiliary channel of the public category can be deleted.

Group

Use the "Group" feature to group channels in parallel. If you want to perform a Test that requires more than the maximum current transmission capacity of an IV channel, the channels can be grouped in parallel to increase the current.

1) Select continuous IV channels with the same specifications and the same voltage and current range. Parallel channels can only work in the high current range.
2) Ensure that the "Parallel Channels" option is enabled in the Advance Feature Tab of Advance System Config.

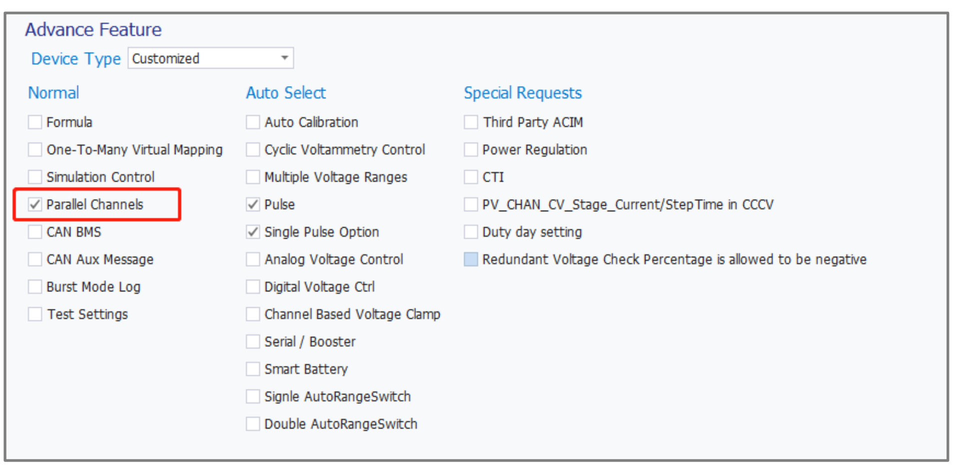


Figure 7-7 Enable Parallel Channels in Advance System Config

a) Note that only the following control types can be completed in parallel:

   i) Current
   ii) Voltage
   iii) C-Rate
   iv) Rest
   v) Power
   vi) Load
   vii) Set Variables
   viii) Current Ramp
   ix) Voltage Ramp
   x) Current Staircase
   xi) Voltage Staircase
   xii) CCCV

3) Left-click and use the drop-down menu to select the IV channels you want to connect in parallel.
4) Click on the “Group” icon in the Mapping Toolbar to successfully group the selected channels in parallel.
5) The current and power of the parallel channels will be combined, and the maximum output charge/discharge current is N*Irange 1. Here “N” is the number of parallel channels and Irange 1 is the current of range 1.

NOTE: The maximum number of parallel channels is 32, the number of the paralleled channels is taken from the smallest number of the channels combined in parallel.

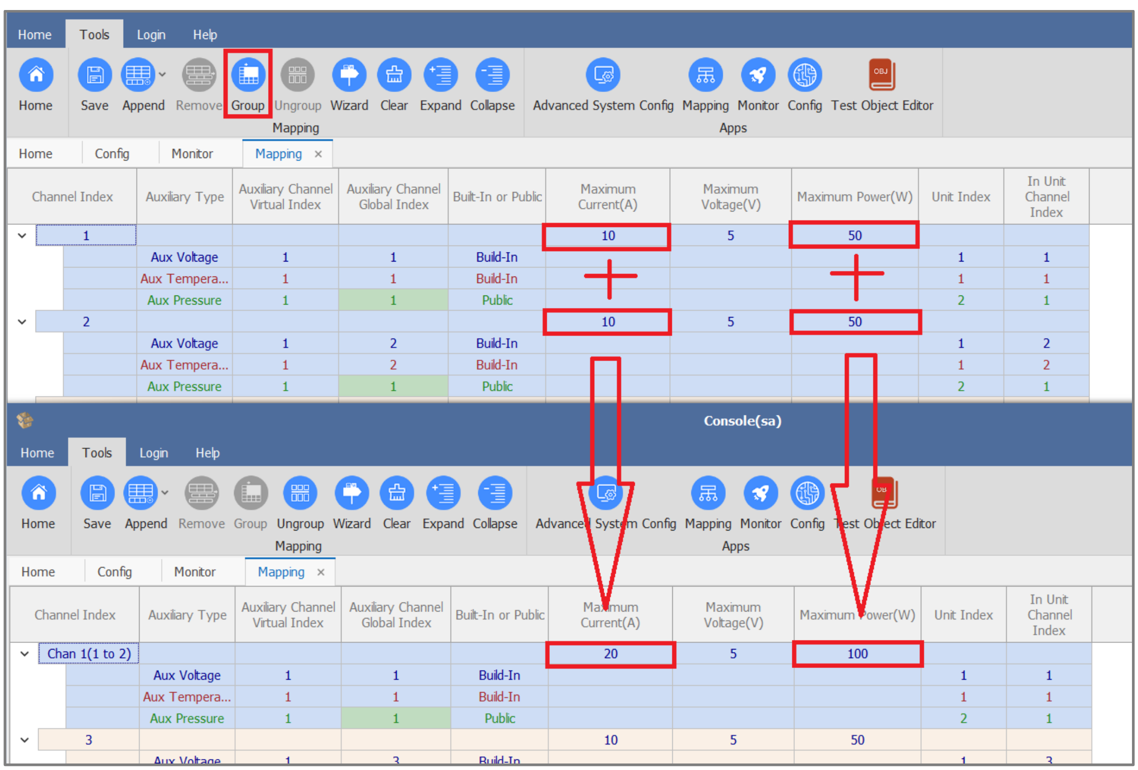
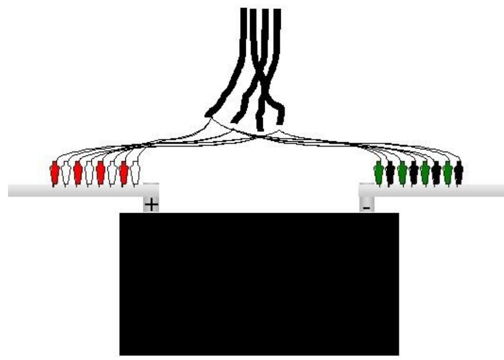


Figure 7-8 The Mapping Toolbar

6) Connect all red insulation (+I) and white insulated (+V) wires to the device (+) terminal, and all black insulated (-I) and green insulated (-V) wires to the device (-) on the terminal. Figure 7-9 shows an example of parallel channel connection.



7-9 Parallel Channel Connection (Example with 4 Channels)

7) Verify that the safety limits of the process are wide enough to accommodate the total current (A) Control Value.
8) In Config, the displayed Current Safety Limit is not affected by parallel operation. The scope of the parallel channels (assuming that there are 4 channels in parallel, each channel has a safety limit of -50 to 50 A in Config) is n * ILIMIT-cfg is the Config Current Safety Limit. In this example, the operating Safety Limit range is 4 * ±50A = ±200A.

Current Safety Limit(A)	
Low	High
-52.5	52.5
-52.5	52.5
-52.5	52.5
-52.5	52.5
-52.5	52.5
-52.5	52.5
-52.5	52.5
-52.5	52.5

	Current Range1 Value(A)	
	Min	Max
1	-50	50
2	-50	50
3	-50	50
4	-50	50
5	-50	50
6	-50	50
7	-50	50
8	-50	50

Figure 7-10 Current Range and Safety Limit in Config

9) If the Current Safety Range between the Schedule and the System Configuration is inconsistent, the Schedule will limit the overlap range. For the above example, when the Safety Range of -150A to 250A is set in the Schedule and -200A to 200A is set in the System Configuration, then the actual Limit is -150A to 200A.
10) The data of parallel channels is stored in the first channel of the group (i.e., the main channel). For example, in parallel from channel 4 to channel to channel 8, the data will only be stored on channel 4. In addition, other channels (i.e., the slave channels) will not contain channel data.

NOTE: When you want to make a schedule for parallel channels, please check the parallel range value.

11) In order to map the auxiliary channel to the parallel channel, the user only needs to map the auxiliary channel to the main channel before paralleling.

NOTE: Assign a Schedule to the parallel channel and map the auxiliary channel to the main channel of the IV channel to be paralleled. If you do not follow the above steps, your Test Object may be damaged.

12) Adjacent channels can be connected in parallel in the same unit or between units.
13) Only the auxiliary channel mapped to the main channel can be used and the data recorded.

Ungroup

Use the "Ungroup" feature to cancel a parallel connection.

1) Click to select the channel for which you want to cancel the parallel connection.
2) Click on the "Ungroup" icon in the Mapping Toolbar to cancel the parallel connection.

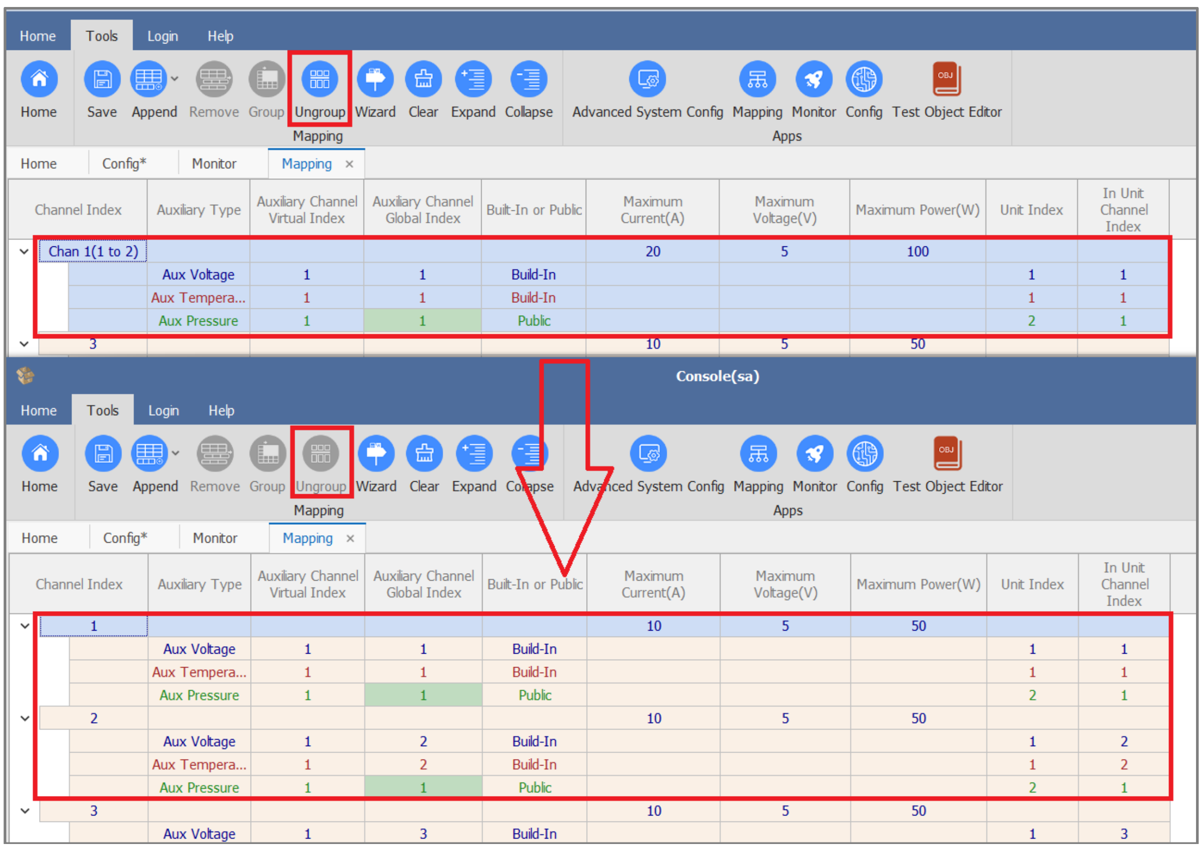


Figure 7-11 Ungroup Channels

If multiple channels are grouped in parallel, the safety mechanisms of all single channels are still effective. If any parallel channel triggers an unsafe state, then each parallel channel will stop testing, and Mits X will display an "Unsafe" message in the corresponding first channel in the parallel group.

Mapping Wizard

There are two default styles for Mapping:

1) **One-to-One Mapping** – One auxiliary channel is mapped to one regular channel. Auxiliary channel 1 is mapped to regular channel 1, auxiliary channel 2 is mapped to regular channel 2, and so on.
2) **One-to-Many Mapping** – Multiple auxiliary channels are mapped to a regular channel. Make sure to enable the option One-to-Many Virtual Mapping in the Advanced Feature section of the Advance System Config.

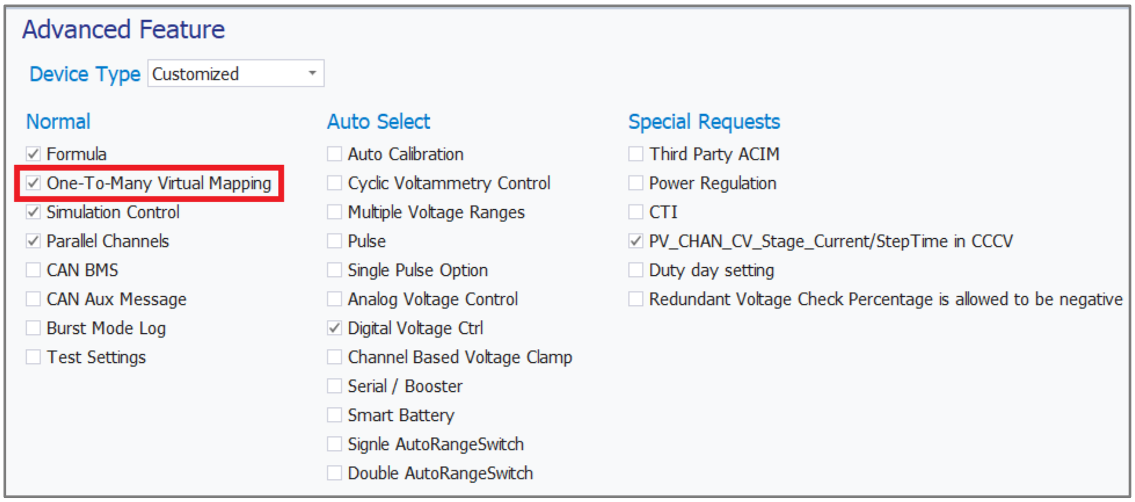


Figure 7-12 Enable One-to-Many Mapping in Advance System Config

Set Default Mapping

1) Click on the "Wizard" icon in the Mapping Toolbar to open the Mapping Wizard.

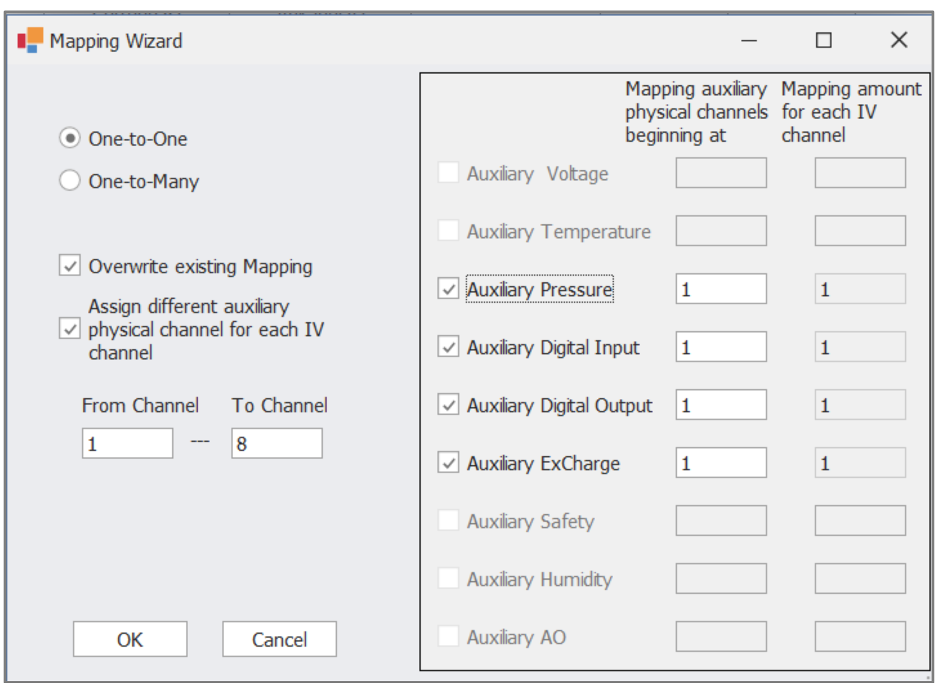


Figure 7-13 The Mapping Wizard

2) Overwrite Existing Mapping: Check this option to overwrite the existing mapping.
3) Assign Different Auxiliary Physical Channels for Each IV Channel: When this option is checked, the software avoids mapping the same auxiliary physical channels to multiple IV channels.
4) In the input boxes under “Mapping Auxiliary Physical Channels Beginning At” and “Mapping Amount for Each IV Channel,” fill in the starting channel number of the auxiliary physical channel to be mapped and the number of auxiliary channels to be allocated for each IV channel.
   a) One-to-One Mapping assigns only one of each selected type of auxiliary physical channel to the IV channel. Therefore, the Auxiliary Virtual Channel Index is always 1.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
	Aux Voltage	1	1	Build-In				1	1
	Aux Tempera...	1	1	Build-In				1	1
	Aux Pressure	1	1	Public				2	1
	Aux Digital In...	1	1	Public				2	1
	Aux Digital Ou...	1	1	Public				2	1
	Aux External ...	1	1	Public				2	1
2					10	5	50		
	Aux Voltage	1	2	Build-In				1	2
	Aux Tempera...	1	2	Build-In				1	2
	Aux Pressure	1	2	Public				2	2
	Aux Digital In...	1	2	Public				2	2
	Aux Digital Ou...	1	2	Public				2	2
	Aux External ...	1	2	Public				2	2
3					10	5	50		
	Aux Voltage	1	3	Build-In				1	3
	Aux Tempera...	1	3	Build-In				1	3
	Aux Pressure	1	3	Public				2	3
	Aux Digital In...	1	3	Public				2	3
	Aux Digital Ou...	1	3	Public				2	3
	Aux External ...	1	3	Public				2	3

Figure 7-14 One-to-One Mapping

   b) One-to-Many Mapping assigns all specific types of auxiliary physical channels to the selected IV channels. Therefore, the Auxiliary Virtual Channel Indexes are arranged in order.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
	Aux Voltage	1	1	Build-In				1	1
	Aux Tempera...	1	1	Build-In				1	1
	Aux Pressure	1	1	Public				2	1
	Aux Pressure	2	2	Public				2	2
	Aux Digital In...	1	1	Public				2	1
	Aux Digital In...	2	2	Public				2	2
2					10	5	50		
	Aux Voltage	1	2	Build-In				1	2
	Aux Tempera...	1	2	Build-In				1	2
	Aux Pressure	1	1	Public				2	1
	Aux Pressure	2	2	Public				2	2
	Aux Digital In...	1	1	Public				2	1
	Aux Digital In...	2	2	Public				2	2
3					10	5	50		

Figure 7-15 One-to-Many Mapping

Clear

Use this feature to remove all auxiliary mapping.

1) Click on the “Clear” icon in the Mapping Toolbar.
2) Click the “Yes” button in the pop-up box that appears to remove all auxiliary mapping except Built-In Mapping.

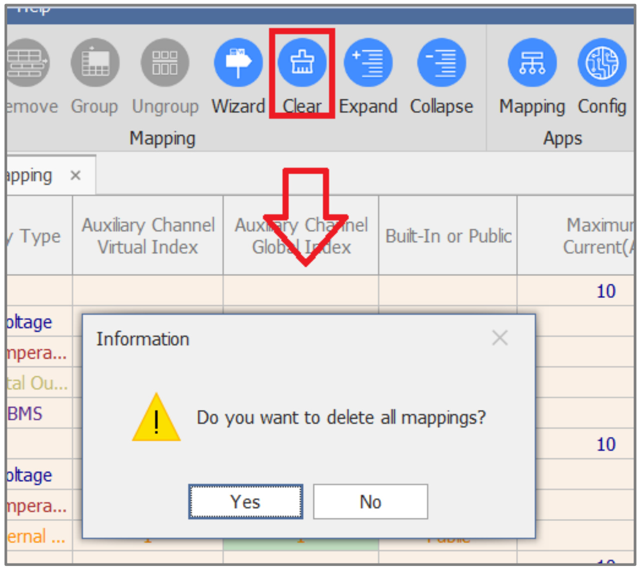


Figure 7-16 Delete All Mapping

Expand

Use this feature to display the Mapping Detailed View.

1) Click on the “Expand” icon in the Mapping Toolbar to expand and display all auxiliary channel information with one click.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
	Aux Voltage	1	1	Build-In				1	1
	Aux Tempera...	1	1	Build-In				1	1
	Aux External ...	1	1	Public				2	1
2					10	5	50		
	Aux Voltage	1	2	Build-In				1	2
	Aux Tempera...	1	2	Build-In				1	2
	Aux Pressure	1	1	Public				2	1
	Aux Digital In...	1	1	Public				2	1
3					10	5	50		
	Aux Voltage	1	3	Build-In				1	3
	Aux Tempera...	1	3	Build-In				1	3
	Aux Pressure	1	1	Public				2	1
	Aux Digital Ou...	1	1	Public				2	1
4					10	5	50		
	Aux Voltage	1	4	Build-In				1	4
	Aux Tempera...	1	4	Build-In				1	4
5					10	5	50		
	Aux Voltage	1	5	Build-In				1	5
	Aux Tempera...	1	5	Build-In				1	5
	Aux External ...	1	1	Public				2	1
6					10	5	50		
	Aux Voltage	1	6	Build-In				1	6
	Aux Tempera...	1	6	Build-In				1	6
	Aux Pressure	1	1	Public				2	1
7					10	5	50		

Figure 7-17 Mapping Detailed View

Collapse

Use this feature to hide the Mapping Detailed View.

1) Click on the “Collapse” icon in the Mapping Toolbar to collapse all auxiliary channel information with one click.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
2					10	5	50		
3					10	5	50		
4					10	5	50		
5					10	5	50		
6					10	5	50		
7					10	5	50		
8					10	5	50		

Figure 7-18 Collapsed View

7.3 Edit Mapping

7.3.1 Mapping Page Settings

The Mapping Page is the area where the auxiliary measurement channels (temperature, pressure, auxiliary voltage, pH, and flow) are mapped to the IV channels. When the appropriate settings are enabled in the Schedule File, the data from these mapped channels will appear in the results of the main IV channel.

Home | Mapping ×

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
	Aux Voltage	1	1	Build-In				1	1
	Aux Tempera...	1	1	Build-In				1	1
	Aux External ...	1	1	Public				2	1
2					10	5	50		
	Aux Voltage	1	2	Build-In				1	2
	Aux Tempera...	1	2	Build-In				1	2
	Aux Pressure	1	1	Public				2	1
	Aux Digital In...	1	1	Public				2	1
3					10	5	50		
	Aux Voltage	1	3	Build-In				1	3
	Aux Tempera...	1	3	Build-In				1	3
	Aux Pressure	1	1	Public				2	1
	Aux Digital Ou...	1	1	Public				2	1
4					10	5	50		
	Aux Voltage	1	4	Build-In				1	4
	Aux Tempera...	1	4	Build-In				1	4
5					10	5	50		
	Aux Voltage	1	5	Build-In				1	5
	Aux Tempera...	1	5	Build-In				1	5
	Aux External ...	1	1	Public				2	1
6					10	5	50		
	Aux Voltage	1	6	Build-In				1	6
	Aux Tempera...	1	6	Build-In				1	6
	Aux Pressure	1	1	Public				2	1

Figure 7-19 The Mapping Page

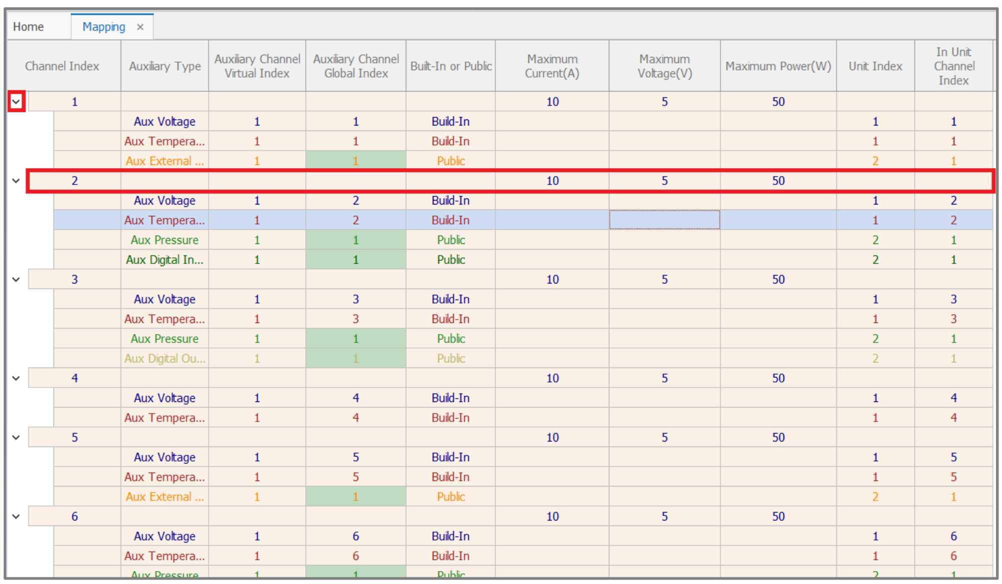
1) **Auxiliary Type** – Identify auxiliary voltage, temperature, pressure, digital input, digital output, external charging, safety, humidity, AO, or pH measurement.
2) **Auxiliary Channel Virtual Index** – Numerical Index of the number of auxiliary inputs assigned to the main IV channel.

3) **Auxiliary Channel Global Index** – Refer to the specific auxiliary channel number displayed on the auxiliary box panel as shown in Figure 7-10 above or recorded in ArbinSys.cfg.
4) **Maximum Current (A)** – Maximum current that the IV channel can provide.
5) **Maximum Voltage (V)** – Maximum voltage that the IV channel can provide.
6) **Maximum Power (A)** – Maximum power that the IV channel can provide.
7) **Unit Index** – Auxiliary unit number.
8) **In Unit Channel Index** – Channel number in the MCU.

7.3.2 Map an Auxiliary Channel

Without pre-defined mapping, users can flexibly map auxiliary channels to IV channels.

1) Click on the arrow icon on the left side of the channel number or double-click the channel row to expand (and collapse) the auxiliary measurement information of the channel.



Home | Mapping ×

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
	Aux Voltage	1	1	Build-In				1	1
	Aux Tempera...	1	1	Build-In				1	1
	Aux External ...	1	1	Public				2	1
2					10	5	50		
	Aux Voltage	1	2	Build-In				1	2
	Aux Tempera...	1	2	Build-In				1	2
	Aux Pressure	1	1	Public				2	1
	Aux Digital In...	1	1	Public				2	1
3					10	5	50		
	Aux Voltage	1	3	Build-In				1	3
	Aux Tempera...	1	3	Build-In				1	3
	Aux Pressure	1	1	Public				2	1
	Aux Digital Ou...	1	1	Public				2	1
4					10	5	50		
	Aux Voltage	1	4	Build-In				1	4
	Aux Tempera...	1	4	Build-In				1	4
5					10	5	50		
	Aux Voltage	1	5	Build-In				1	5
	Aux Tempera...	1	5	Build-In				1	5
	Aux External ...	1	1	Public				2	1
6					10	5	50		
	Aux Voltage	1	6	Build-In				1	6
	Aux Tempera...	1	6	Build-In				1	6
	Aux Pressure	1	1	Public				2	1

Figure 7-20 Expand Auxiliary Channel Information

2) Right-click on the channel to which you want to add mapping.
3) Click on the “Append” option in the menu that comes up.
4) Select the auxiliary measurement type you want to add in the auxiliary measurement type menu that appears. You can also click on the “Append” icon in the Mapping Toolbar to add mapping.

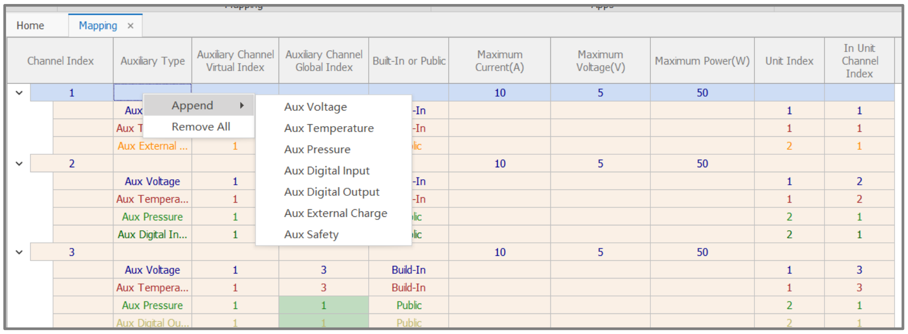


Figure 7-21 Append Mapping

a) Only when the hardware is configured this way will the auxiliary measurement type be enabled. (Please refer to the description of the System Configuration File in 12 for more information.)

b) For example, if the hardware system is configured with 8 auxiliary voltage channels and 8 auxiliary temperature channels, then Auxiliary Voltage and Auxiliary Temperature will be enabled in the auxiliary measurement type menu. All other types will be disabled.

NOTE: The system is completely configured through the factory ArbinSys.cfg. Under normal circumstances, users are not able to modify these system-level parameters.

5) Enter the auxiliary channel number in the field under Auxiliary Physical Channel Index.
   a) For example, if you want to use auxiliary voltage channel 1 to measure the voltage change of the battery connected to the main IV channel 1, enter "1" in this field.
   b) Please note that only the cells shown in green are editable, the rest are not.

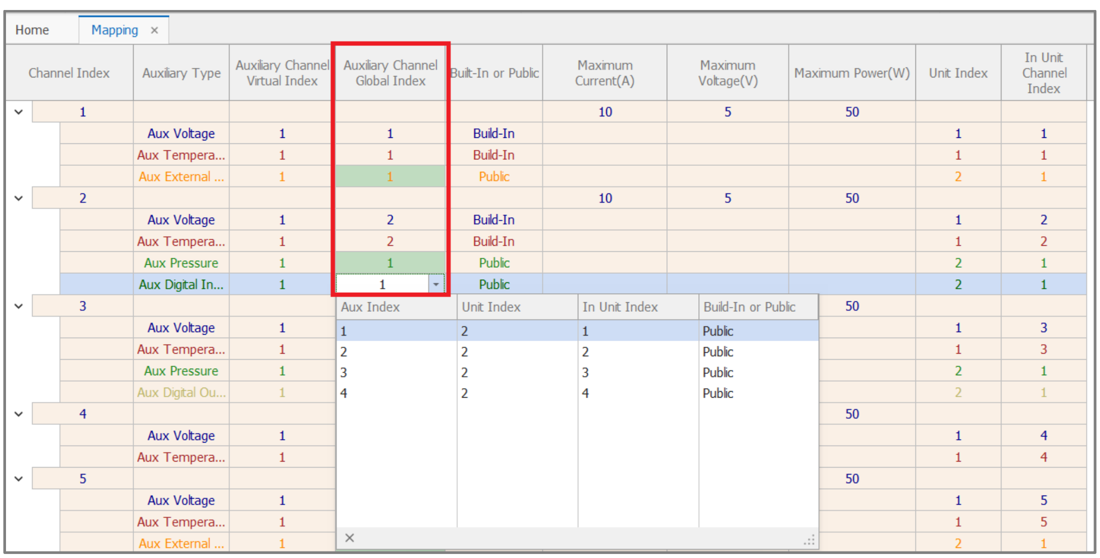


Figure 7-22 Enter the Auxiliary Channel Number

6) To map more auxiliary measurement channels, repeat steps 2 through 5.

NOTE: Regardless of the specification of the Auxiliary Physical Channel Index, each new auxiliary input referenced by the Auxiliary Virtual Channel Index is incremented.

7.3.3 Delete an Auxiliary Channel

1) Right-click on the auxiliary channel you want to delete to select it.
2) Click on the "Remove" option on the menu that appears to delete the selected auxiliary channel.

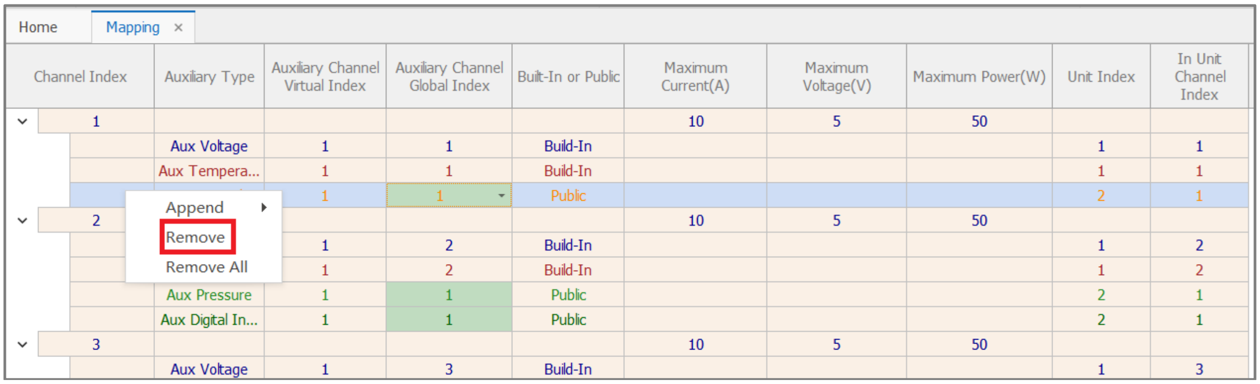


Figure 7-23 Delete an Auxiliary Channel

7.3.4 Delete All Auxiliary Channels under a Channel

1) Right-click on the auxiliary channel you want to delete to select it.
2) Click on the "Remove All" option on the menu that appears to delete all auxiliary channels under the selected channel.

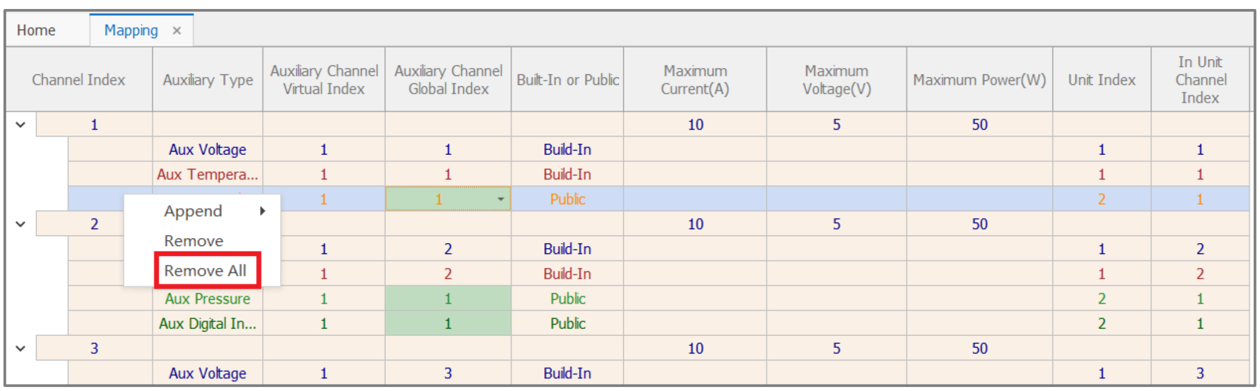


Figure 7-24 Delete All Auxiliary Channels Under the Selected Channel

8: The Simulation Editor

8.1 Introduction to Simulation

8.1.1 What is Simulation?

Simulation refers to the function of using data collected from an unformulated dynamic state (i.e., outside of CI, CV, CP, ramp, step, pulse, or formula) as the input of a control. In some cases, Arbin customers are developing batteries whose performance is characterized by discrete, non-periodical discharge or charging energy changes. Mits X can perform two types of simulation: current/power/load simulation and battery simulation.

8.1.2 The Simulation Editor

Open the Simulation Editor

1) Double-click the "Simulation Editor" icon in Mits X to open the Simulation Editor.

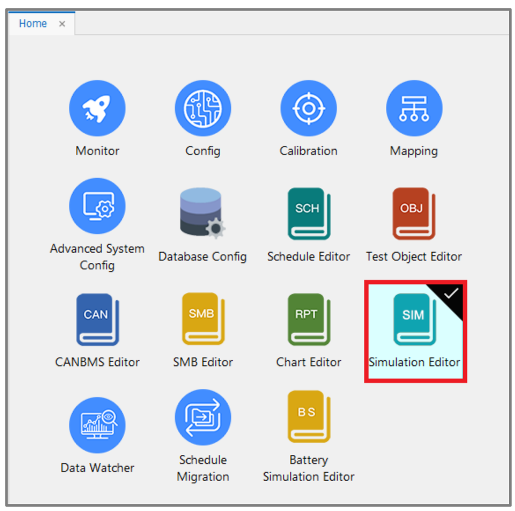


Figure 8-1 The Simulation Editor Icon

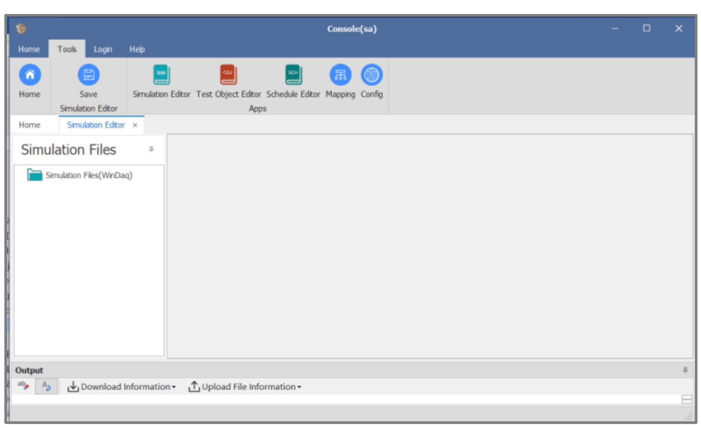


Figure 8-2 The Simulation Editor

Open the Simulation Editor Locally

1) Right-click on the “Simulation Editor” icon in Mits X.
2) Click on the “Open This App Locally” option that appears.

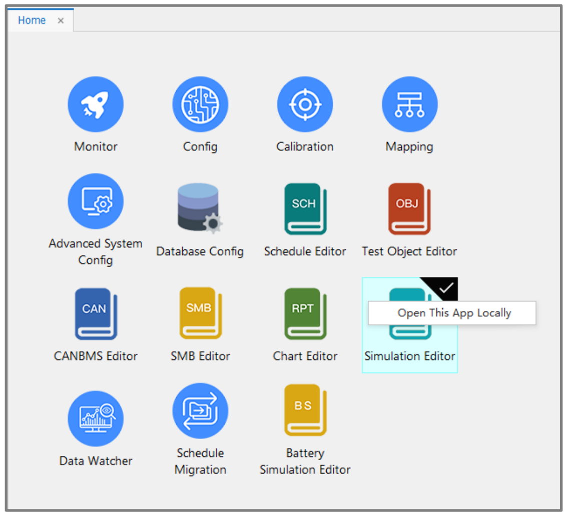


Figure 8-3 Open the Simulation Editor Locally

8.2 Manage Simulation Files

8.2.1 Enable Simulation Control

1) On the Advanced Feature Tab of Advanced System Config, enable simulation control by checking the “Simulation Control” option.
2) If this option is not checked, the four simulation control types in Schedule will not be available.

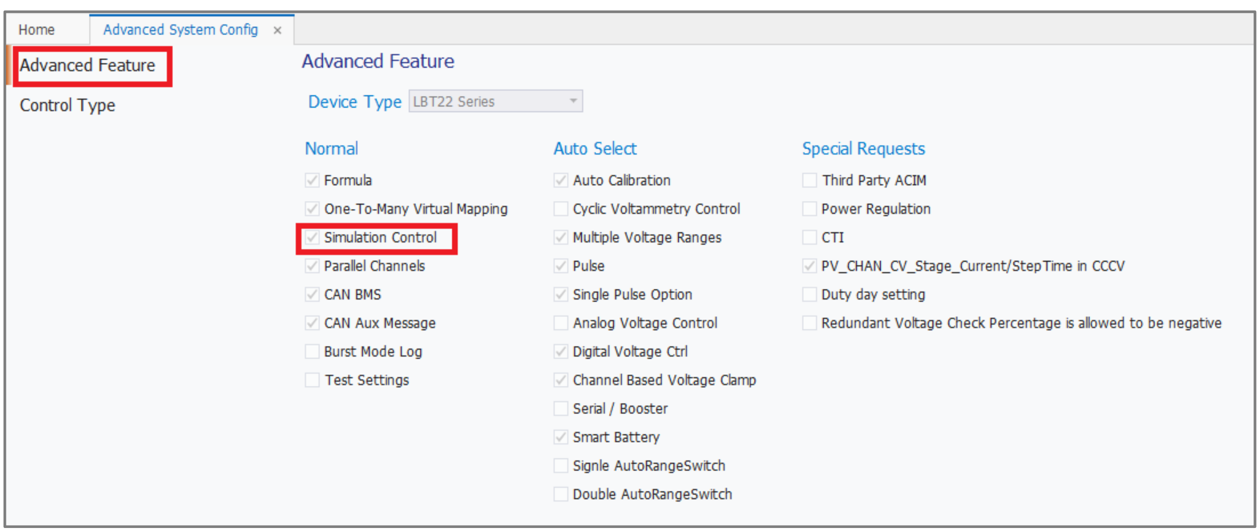


Figure 8-4 Enable Simulation Control in Advanced System Config

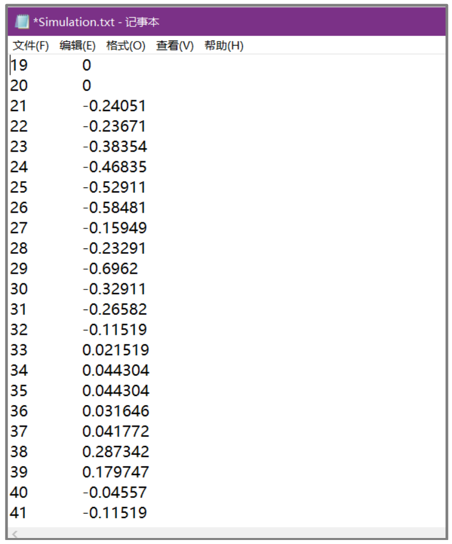
8.2.2 Create a Simulation File

Current/power/load simulation files start with time-domain data sets in current, voltage, power, or load. These data sets are collected by various methods, such as Arbin's external load, charging adapter (See **Chapter 18: Hardware Technical Overview**), third-party data recorders, or Standard Configuration File. Import the dataset into Excel or text file.

A sample data set in spreadsheet format is shown below.

time (s)	current (A)
19	0
20	0
21	-0.24051
22	-0.23671
23	-0.38354
24	-0.46835
25	-0.52911
26	-0.58481
27	-0.15949
28	-0.23291
29	-0.6962
30	-0.32911
31	-0.26582
32	-0.11519
33	0.021519
34	0.044304
35	0.044304
36	0.031646
37	0.041772
38	0.287342
39	0.179747
40	-0.04557
41	-0.11519
42	-0.11772
43	-0.1619
44	-0.30127

1) Create a simulation file in one of two ways:
   a) From a Text File:
      i) Save the dataset in a text file format (*.txt) in the directory C:\MitsX\hostcomputer\WinDaq\Profiles_Simulation, formatted like Figure 8-5.
      ii) Note that there is no column heading. The columns are time and current, which means that the current remains at y before time x.

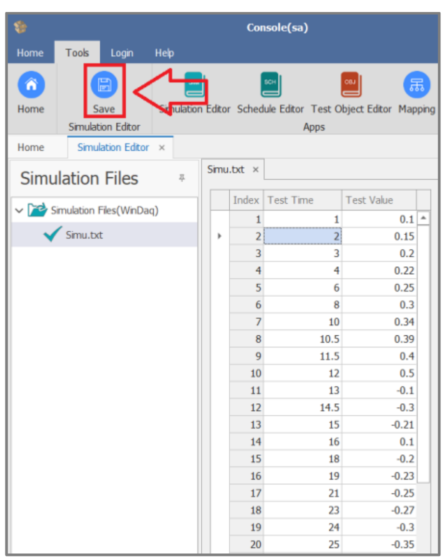

*Simulation.txt - 记事本

文件(F) 编辑(E) 格式(O) 查看(V) 帮助(H)

19	0
20	0
21	-0.24051
22	-0.23671
23	-0.38354
24	-0.46835
25	-0.52911
26	-0.58481
27	-0.15949
28	-0.23291
29	-0.6962
30	-0.32911
31	-0.26582
32	-0.11519
33	0.021519
34	0.044304
35	0.044304
36	0.031646
37	0.041772
38	0.287342
39	0.179747
40	-0.04557
41	-0.11519

Figure 8-5 Data Entered in the Form of a Text File

   b) From the Simulation File Directory:
      i) Right-click on the Simulation File Directory in the Simulation Editor.
      ii) Click on the "New File" option on the menu that appears to create a new Simulation File.
2) After inputting data, click on the "Save" icon in the Simulation Editor Toolbar to save the changes.



Index	Test Time	Test Value
1	1	0.1
2	2	0.15
3	3	0.2
4	4	0.22
5	6	0.25
6	8	0.3
7	10	0.34
8	10.5	0.39
9	11.5	0.4
10	12	0.5
11	13	-0.1
12	14.5	-0.3
13	15	-0.21
14	16	0.1
15	18	-0.2
16	19	-0.23
17	21	-0.25
18	23	-0.27
19	24	-0.3
20	25	-0.35

Figure 8-6 Save the Simulation File Changes

8.2.3 Open a Simulation File

1) The system will automatically open a new Simulation File that you create.
2) Open an existing Simulation File in one of two ways:
    a) Double-Click:
        i) In the Simulation File Directory, double-click on the file name of the Simulation File you want to open.
    b) Right Click:
        i) In the Simulation File Directory, right-click on the file name of the Simulation File you want to open.
        ii) Click on the "Open File" option in the menu that appears to open the selected Simulation File.

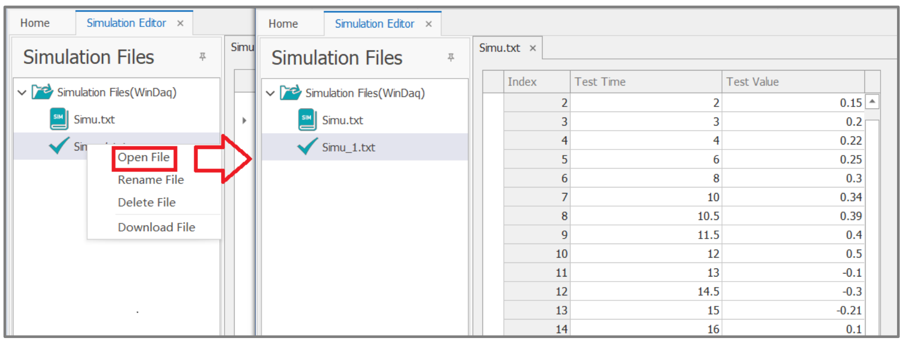


Figure 8-7 Open the Selected Simulation File

8.2.4 Upload a Simulation File

1) In the Simulation File Directory, right-click on the main Simulation Files folder.
2) Click on the "Upload File" option in the menu that appears.
3) In the Select Files Interface, navigate to and select the Simulation File you want to upload to the Simulation File Directory.
4) Click the "Open" button at the bottom of the Select Files Interface to upload the selected Simulation File.

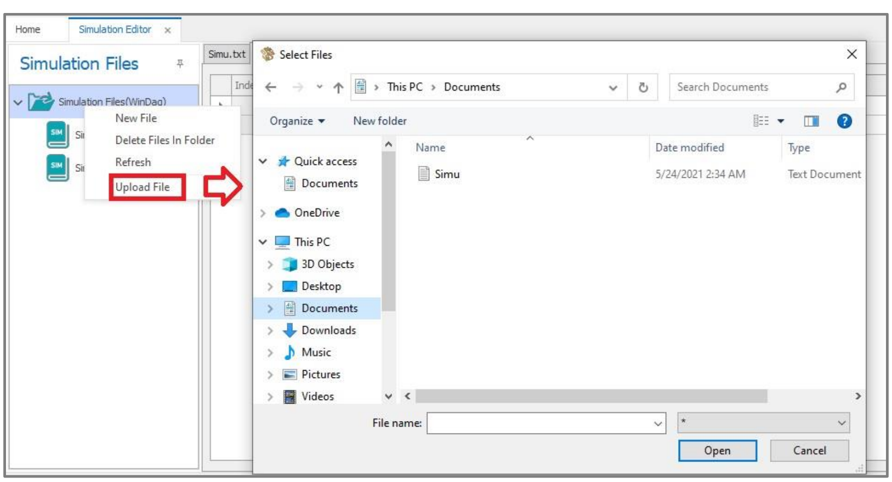


Figure 8-8 Upload the Selected Simulation File

8.2.5 Rename a Simulation File

1) In the Simulation File Directory, right-click on the file name of the Simulation File you want to rename in the Simulation File Directory.
2) Click on the “Rename File” option in the menu that appears.
3) Enter the new file name in the Name input box.
4) Click the “OK” button to save the new Simulation File name.

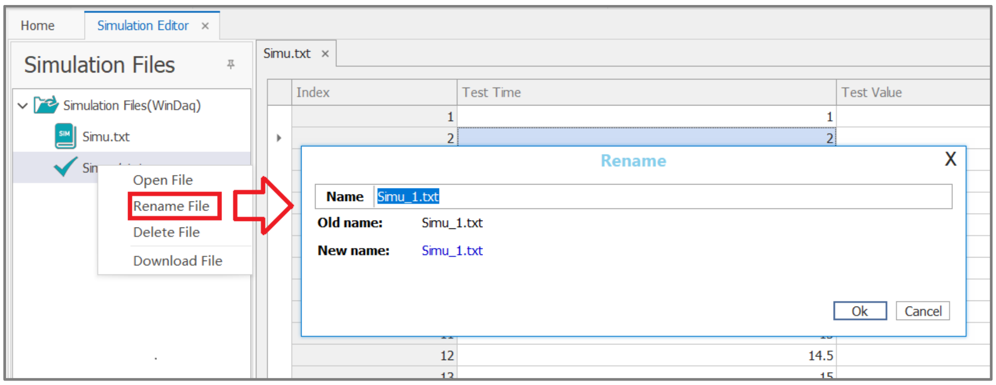


Figure 8-9 Rename a Simulation File

8.2.6 Download a Simulation File

1) In the Simulation File Directory, right-click on the file name of the Simulation File you want to download.
2) Click on the “Download File” option in the menu that appears.
3) In the “Save As” Interface, select the path and location where you want to save the Simulation File.
4) Click the “Save” button at the bottom of the “Save As” Interface to save the selected Simulation File to the selected location.

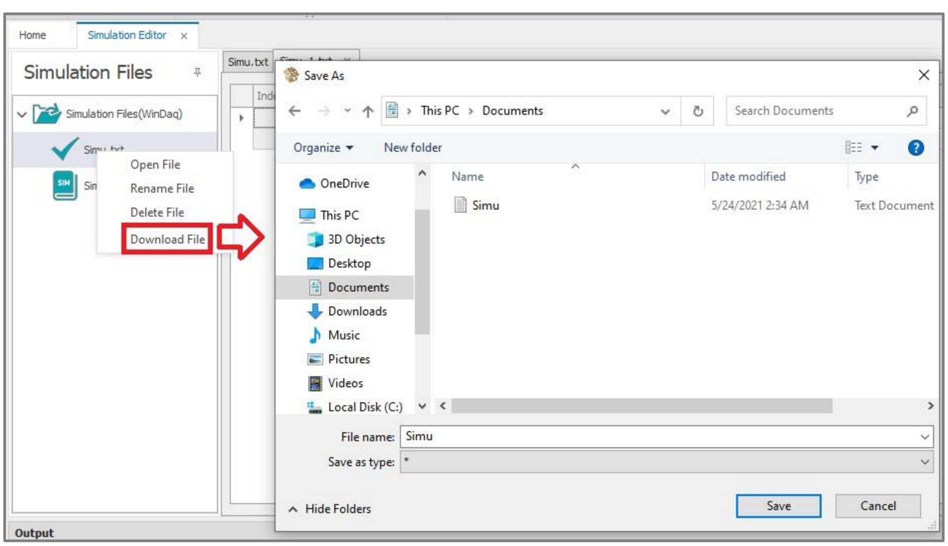


Figure 8-10 Download a Simulation File

8.2.7 Delete a Simulation File

1) In the Simulation File Directory, right-click on the file name of the Simulation File you want to delete.
2) Click on the "Delete File" option in the menu that appears.
3) Click the "OK" button in the dialog box that appears to confirm deletion of the selected Simulation File.

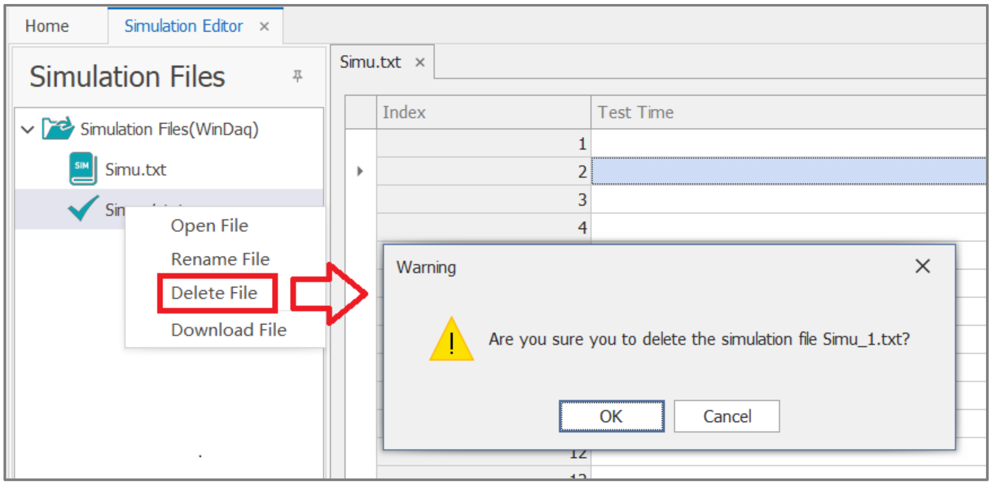


Figure 8-11 Delete a Simulation File

8.3 Manage the Simulation File Directory

8.3.1 Refresh the Simulation File Directory

1) In the Simulation File Directory, right-click on the main Simulation Files folder.
2) Click on the "Refresh" option in the menu that appears to refresh the Simulation File Directory.

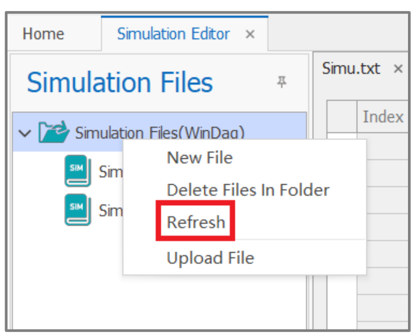


Figure 8-12 Refresh the Simulation File Directory

8.3.2 Delete All Files in the Simulation File Directory

1) Right-click on the main Simulation Files Folder in the Simulation File Directory.
2) Click on the "Delete Files in Folder" option in the menu that appears.
3) Click the "OK" button in the dialog box that appears to delete all Simulation Files in the main Simulation Files folder.

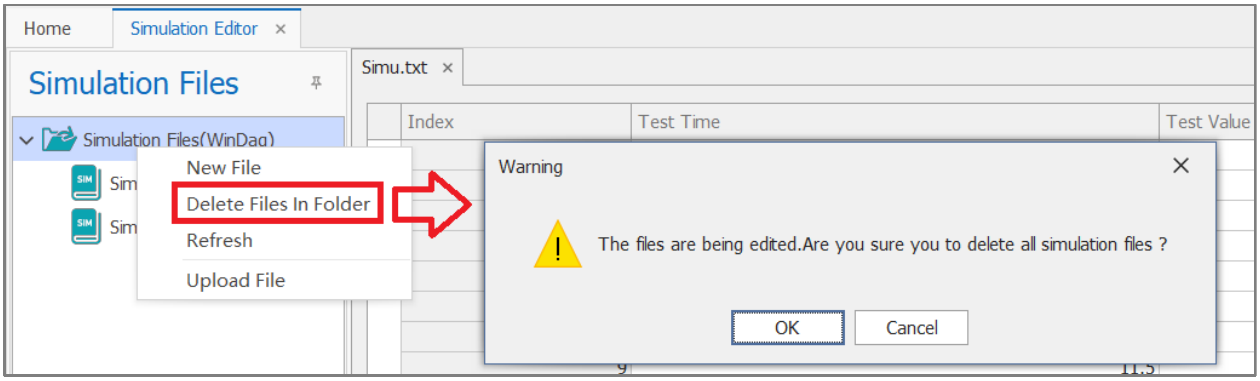


Figure 8-13 Delete All Files in the Simulation File Directory

8.4 Current/Power/Load Simulation

8.4.1 Introduction to Current/Power/Load Simulation

Consider the time-domain current profile in Figure 8-14.

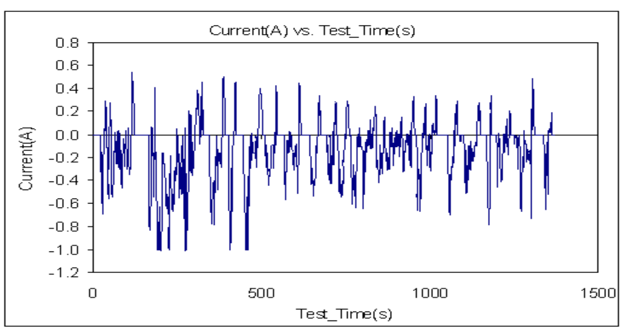


Figure 8-14 Unformatted Time-Domain Test Sequence

This profile cannot be copied by any of the traditionally available control types. However, with the unique flexibility of simulation control, users can easily copy this arbitrary temporary function as a complex control parameter, called a Simulation File.

8.4.2 Edit the Current/Power Load Simulation Process

1) In the Schedule File, under Control Type select either Current Simulation, Power Simulation, or Load Simulation.

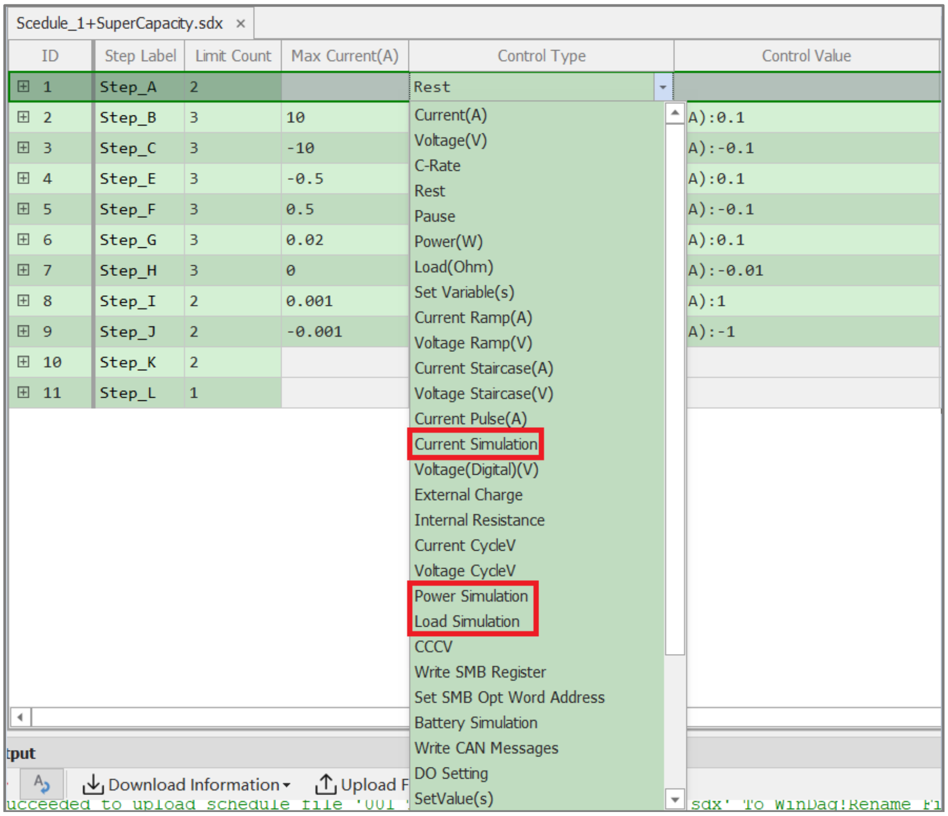


Figure 8-15 Select the Control Type

2) Right-click on the box under Control Value.
3) Click on the “Assign Simulation File” option in the menu that appears to open the Assign Simulation Interface and select a Simulation File to be used.

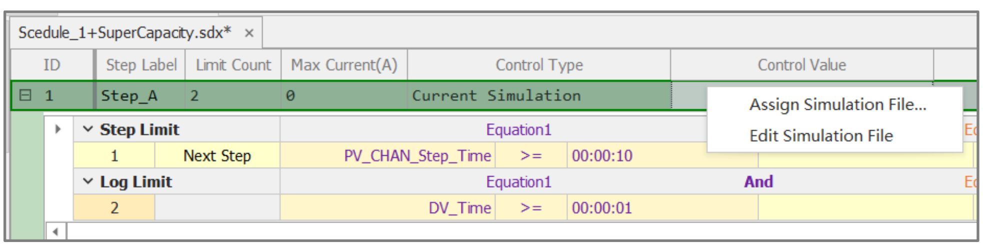


Figure 8-16 Simulation File Management

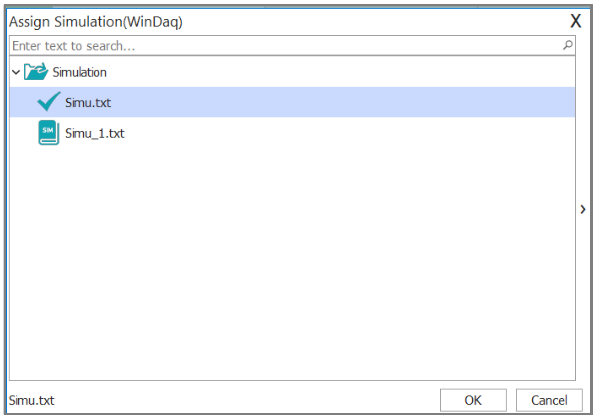


Figure 8-17 Select a Simulation File

4) Assuming that the duration in the document is 500s, we can set the Step Limit of the Step as 501s. Figure 8-8 below shows how to set the Step and Log Limits.

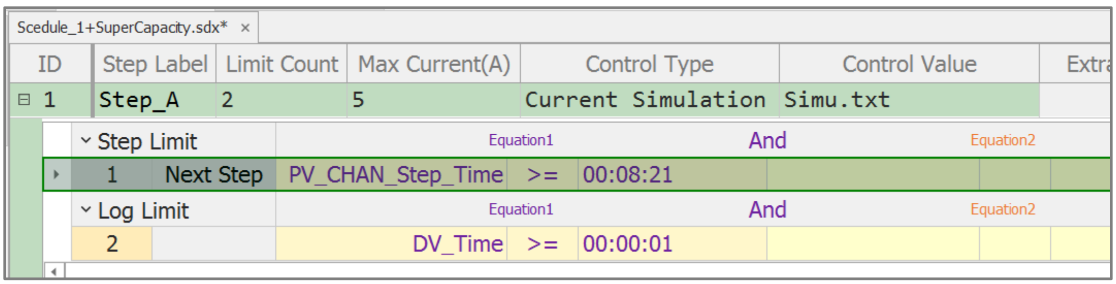


Figure 8-18 Set the Step and Log Limits

5) If you want to repeat this Simulation program multiple times, for example, 3 times, you can select "repeat, no extra 2 points" or "repeat with 2 extra points," then set the Step Limit of the Schedule Step to 1501s. The extra two points are to record the leading and trailing edges of each cycle.

NOTE: Simulation control is not designed to achieve high-speed transients in order to get the best Test results, the events represented in the Simulation File should be resolved with >0.01s. Excessive use of the software may produce unexpected results and may adversely affect the performance of the test equipment.

The software can provide up to 1.2 million points in the specified Simulation File; the minimum setting interval is 10ms and the longest setting interval is 30 days. If it is a single-channel system, the shortest log interval is 1ms/log. In a Schedule, up to 50 simulations can be allocated. For advice on testing requirement, please consult Arbin Customer Support.

9: The Chart Editor

9.1 Introduction to the Chart Editor

9.1.1 What is the Chart Editor?

The Chart Editor is used to edit the data display format in DataWatcher, including chart color, font, coordinate axis, etc.

9.1.2 Open the Chart Editor

Open the Chart Editor

There are two ways to open the Chart Editor normally:

1) On the Mits X home screen, double-click on the Chart Editor icon.
2) On the main Mits X Menu Toolbar, click on the Chart Editor icon.

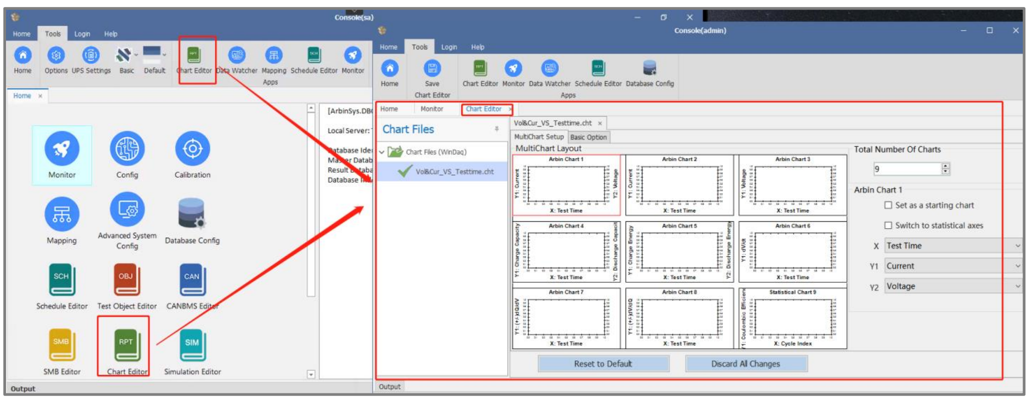


Figure 9-1 Two Ways to Open the Chart Editor

Open the Chart Editor Locally

1) On the Mits X home screen, right-click on the “Chart Editor” icon.
2) Click on the “Open This App Locally” option to open the Chart Editor locally.

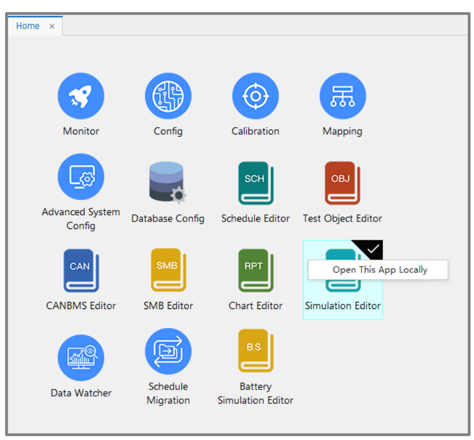


Figure 9-2 Open the Chart Editor Locally

9.2 Manage Chart Files

9.2.1 Create a New Chart File

1) In the Chart File Directory, right-click on the main Chart Files Folder.
2) Click on the “New File” option in the menu that appears to create a new Chart File.
3) The Chart File name and content are populated with default values, which can be changed after the Chart File is created.

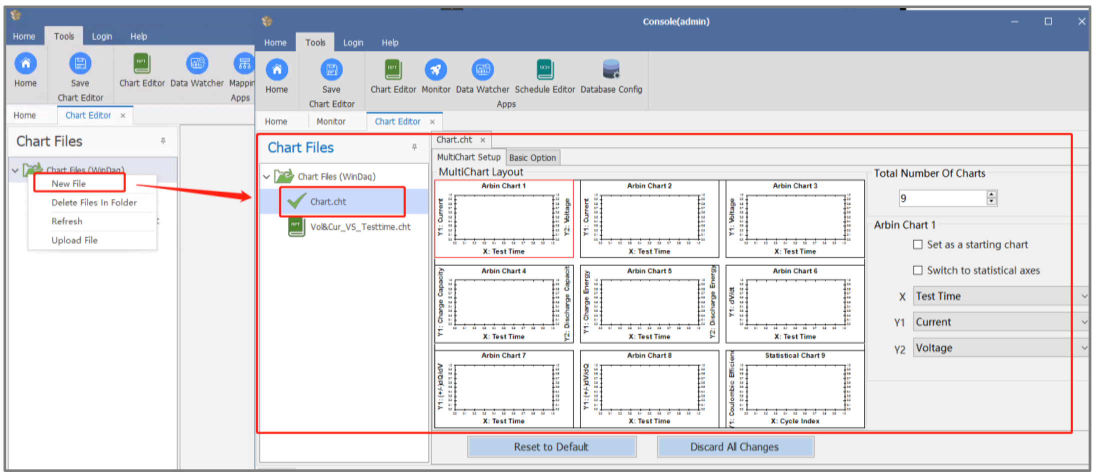


Figure 9-3 Create a New Chart File

9.2.2 Open a Chart File

1) The system will automatically open a new Chart File that you create.
2) Open an existing Chart File in one of two ways:
   a) Double-Click:
      i) In the Chart File Directory, double-click on the file name of the Chart File you want to open.
   b) Right Click:
      i) In the Chart File Directory, right-click on the file name of the Chart File you want to open.
      ii) Click on the “Open File” option in the menu that appears to open the selected Chart File.

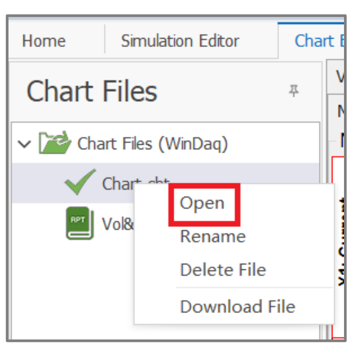


Figure 9-4 Open a Chart File

9.2.3 Upload a Chart File

1) In the Chart File Directory, right-click on the main Chart Files folder.
2) Click on the "Upload File" option in the menu that appears.
3) In the "Select Files" Interface, navigate to and select the Chart File you want to upload to the Chart File Directory.
4) Click the "Open" button at the bottom of the "Select Files" Interface to upload the selected Chart File.

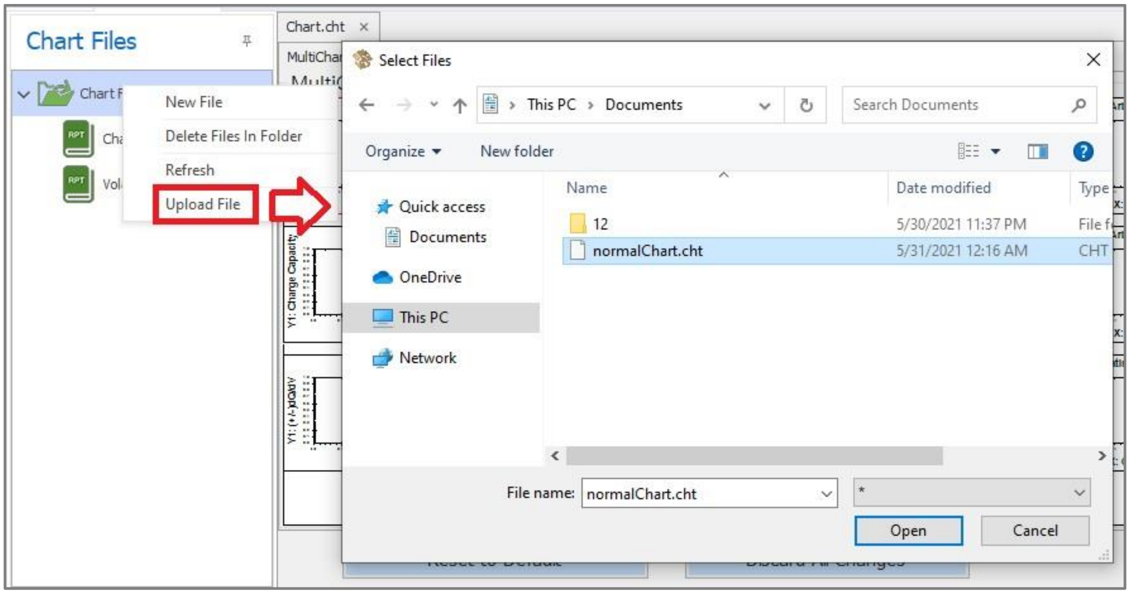


Figure 9-5 Upload a Chart File

9.2.4 Rename a Chart File

1) In the Chart File Directory, right-click on the file name of the Chart File you want to rename in the Chart File Directory.
2) Click on the "Rename File" option in the menu that appears.
3) Enter the new file name in the Name input box.
4) Click the "OK" button to save the new Chart File name.

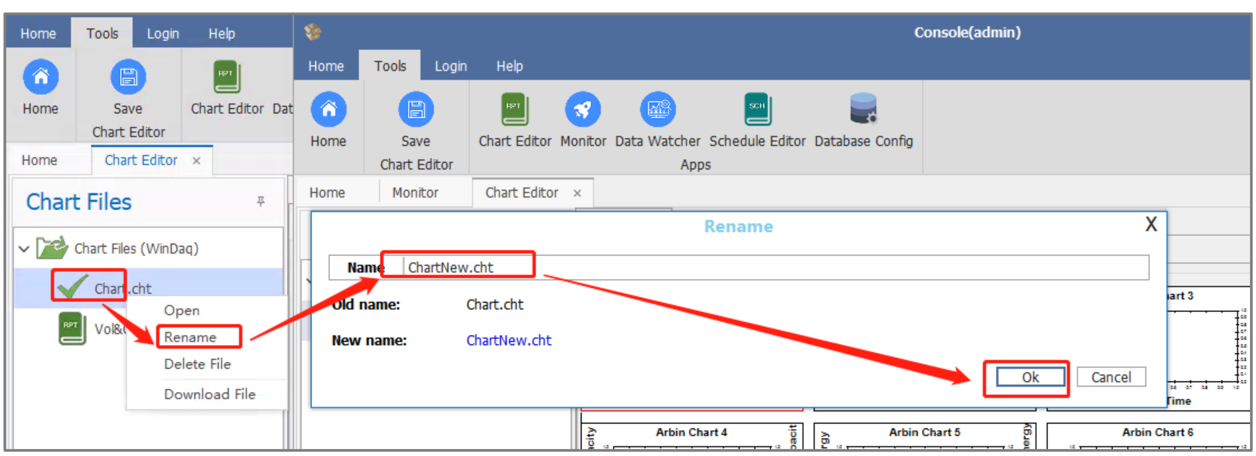


Figure 9-6 Rename a Chart File

9.2.5 Download a Chart File

1) In the Chart File Directory, right-click on the file name of the Chart File you want to download.
2) Click on the "Download File" option in the menu that appears.
3) In the "Save As" Interface, select the path and location where you want to save the Chart File.
4) Click the "Save" button at the bottom of the "Save As" Interface to save the selected Chart File to the selected location.

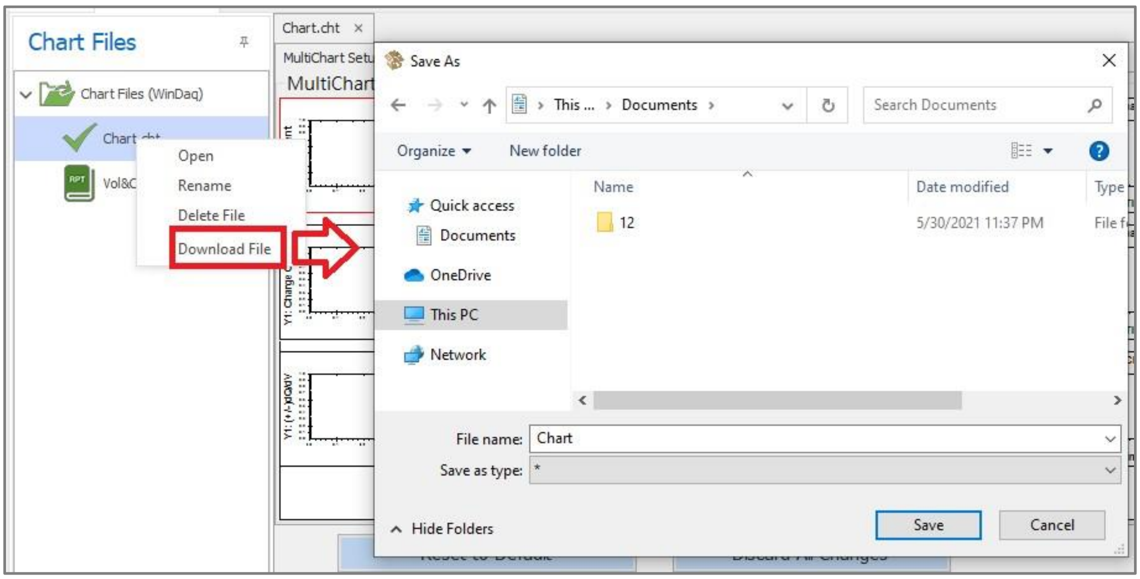


Figure 9-7 Download a Chart File

9.2.6 Delete a Chart File

1) In the Chart File Directory, right-click on the file name of the Chart File you want to delete.
2) Click on the "Delete File" option in the menu that appears.
3) Click the "OK" button in the dialog box that appears to confirm deletion of the selected Chart File.

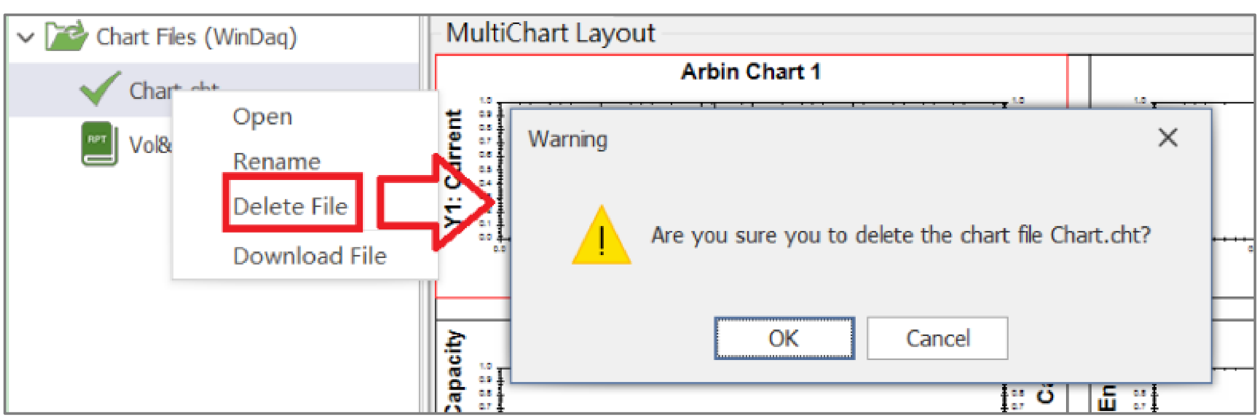


Figure 9-8 Delete a Chart File

9.3 Manage the Chart File Directory

9.3.1 Refresh the Chart File Directory

1) In the Chart File Directory, right-click on the main Chart Files folder.
2) Click on the “Refresh” option in the menu that appears to refresh the Chart File Directory.

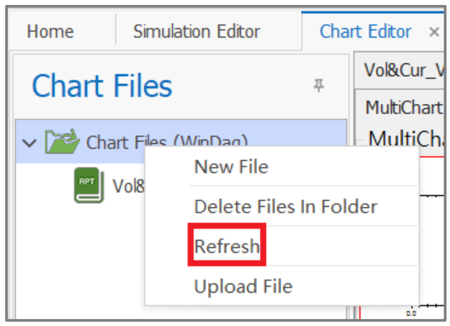


Figure 9-9 Refresh the Chart File Directory

9.3.2 Delete All Files in the Chart File Directory

1) In the Chart File Directory, right-click on the main Chart Files Folder.
2) Click on the “Delete Files in Folder” option in the menu that appears.
3) Click the “OK” button in the dialog box that appears to confirm deletion of all Chart Files in the main Chart Files Folder.

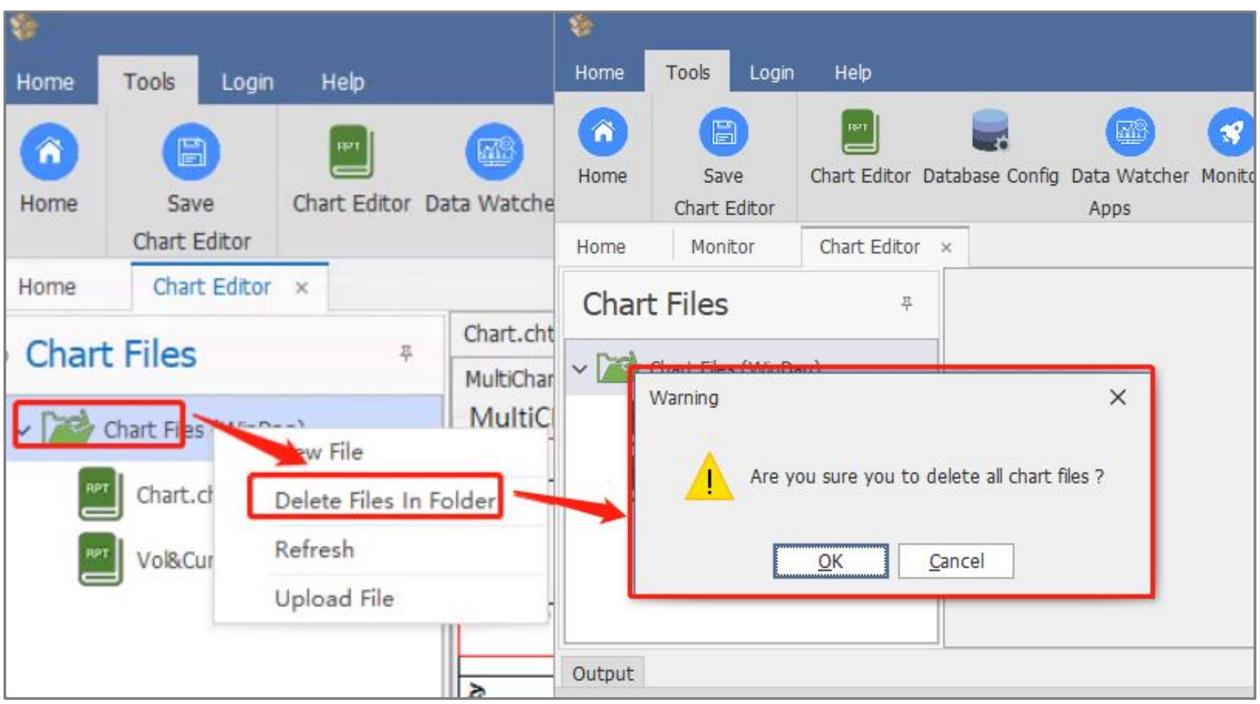


Figure 9-10 Delete All Chart Files in Main Chart Files Folder

9.4 Edit Chart File Settings

After opening a Chart File, the file will have two editing pages, MultiChart Setup and Basic Options. To save any changes made to a Chart File, click on the "Save" icon in the Chart Editor Toolbar.

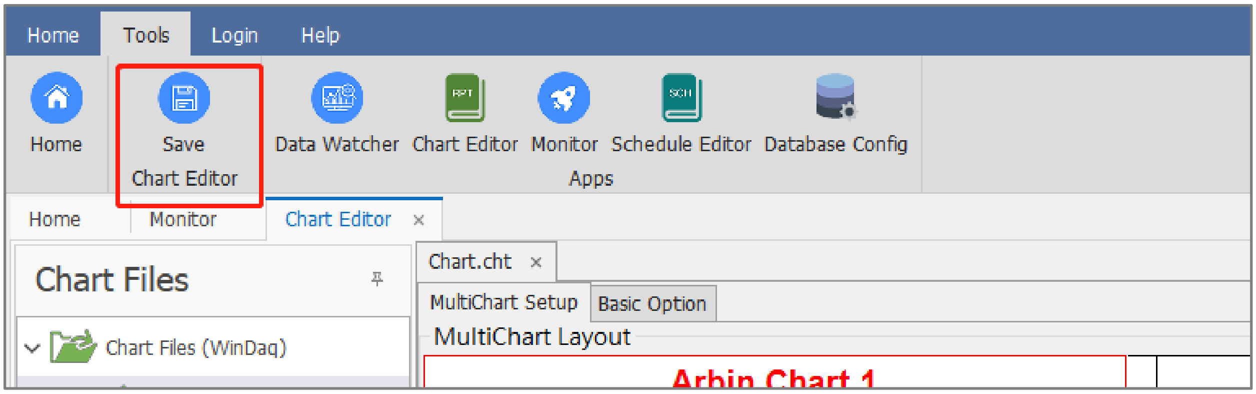


Figure 9-11 Save Changes to an Edited Chart File

9.4.1 Configure the MultiChart Setup Page

Select the Chart Settings

1) **Total Number of Charts** – Set the total number of charts (1-9); the default number is 9.
2) **Arbin Chart X** – Click the chart on the page to configure it separately, where X represents that number label of the chart.
3) **Set as a Starting Chart** – Set the currently selected chart as the started chart.
    a) For example, the selected chart in Figure 9-12 is Arbin Chart 2.
    b) After checking the "Set as a Starting Chart" option, the title of Arbin Chart 2 will turn red, the selected channel will open DataWatcher from Mits X, and DataWatcher will display only Arbin Chart 2 by default.

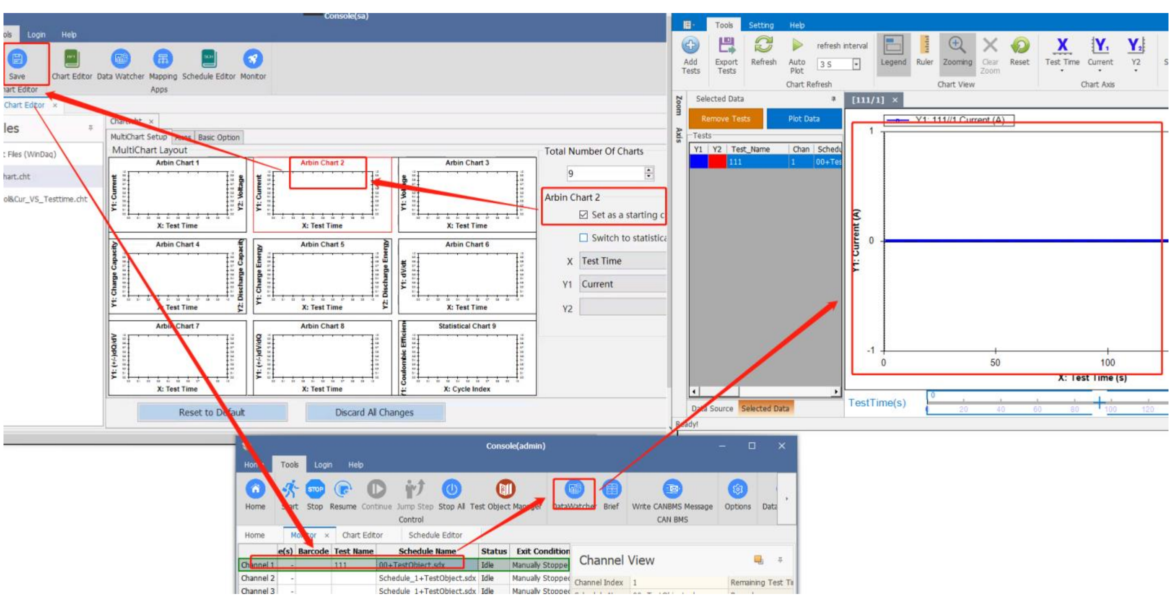


Figure 9-12 Set as a Starting Chart

4) **Switch to Statistical Axes** – Change the data source statistics of the selected chart. The chart title will also change to Statistical Chart X.

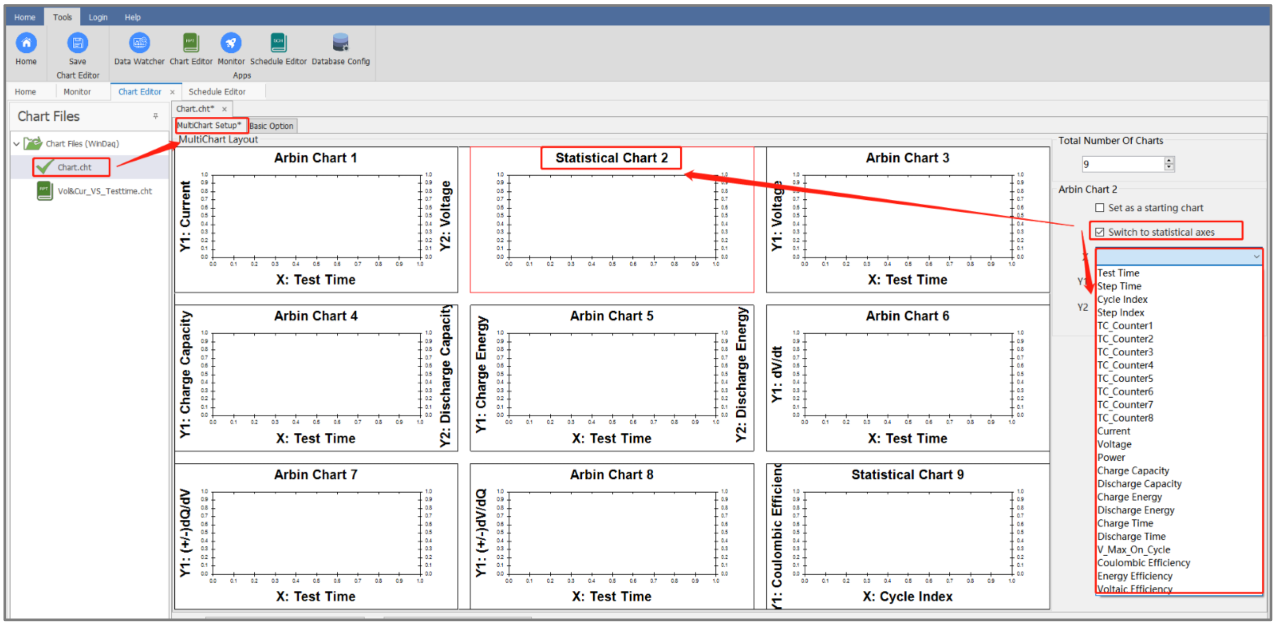


Figure 9-13 Switch to Statistical Axes

5) **X, Y1, Y2** – Set the display content of the three coordinate axes of the icon respectively.

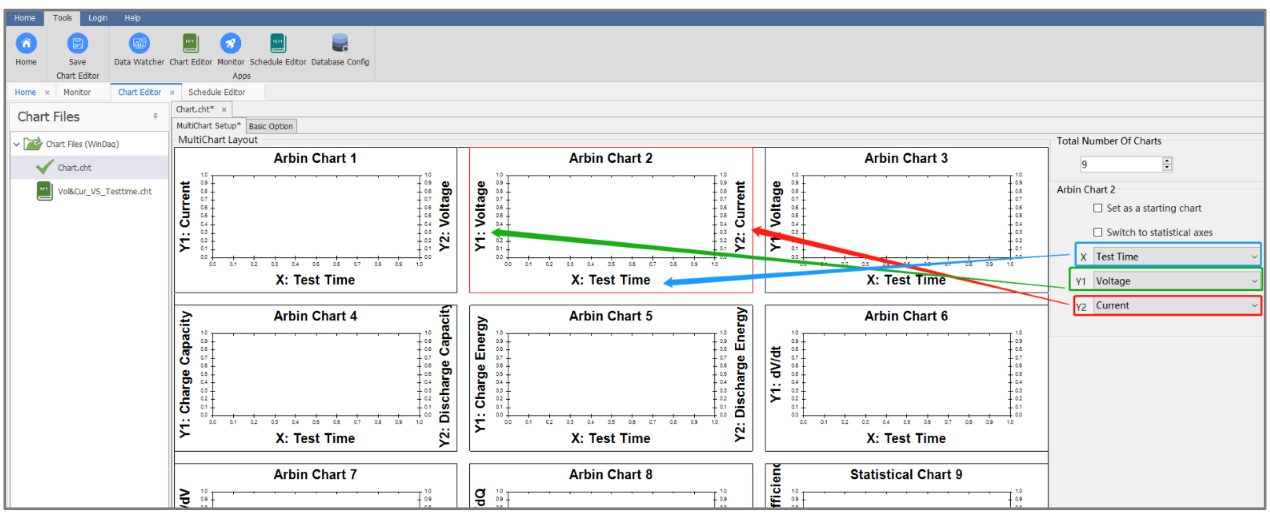


Figure 9-14 X1, Y1, Y2

Reset to the Default Chart Settings

1) Click the “Reset to Default” button at the bottom of the “Chart Editor” Interface.
2) Click “OK” in the dialog box that appears to reset all Chart File settings to the default settings.

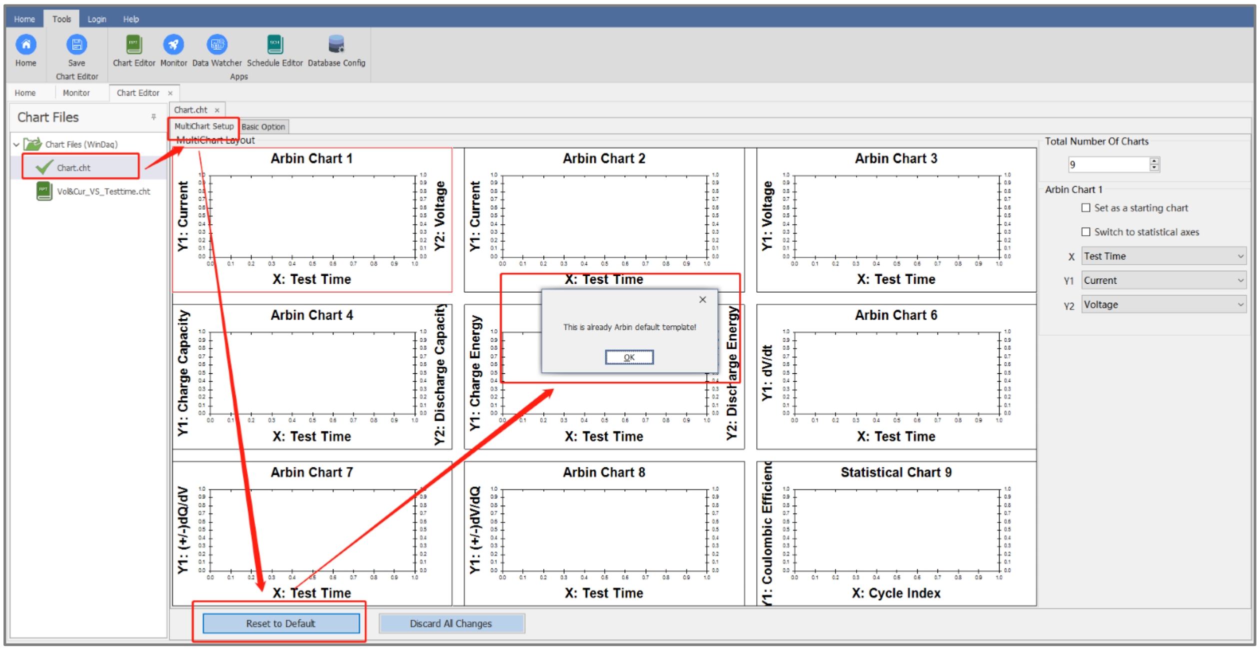


Figure 9-15 Reset to the Default Chart File Settings

Discard All Chart Setting Changes

1) Click the “Discard All Changes” button at the bottom of the “Chart Editor” Interface.
2) Click “OK” in the dialog box that appears to discard all Chart File changes.

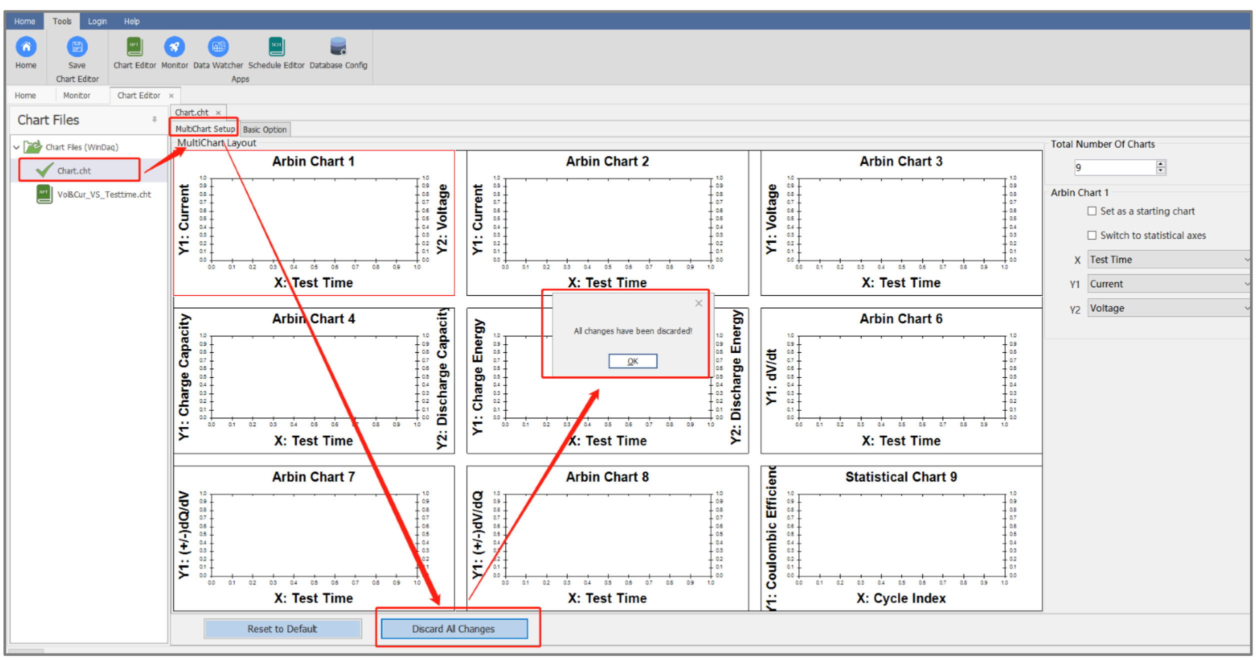


Figure 9-16 Discard All Chart File Changes

9.4.2 Configure the Basic Options Page

The Basic Options page allows you to set the font, font size, and position of the legend, as well as the display of points and lines, and the background color of the charts.

Configure the Legend Style

The Legend provides information on the dataset appearing in the chart. The "Legend" options on the Basic Options Page control the display styles of the Legend.

1) **Legend** – Click the checkmark box next to "Legend" to display the Legend.

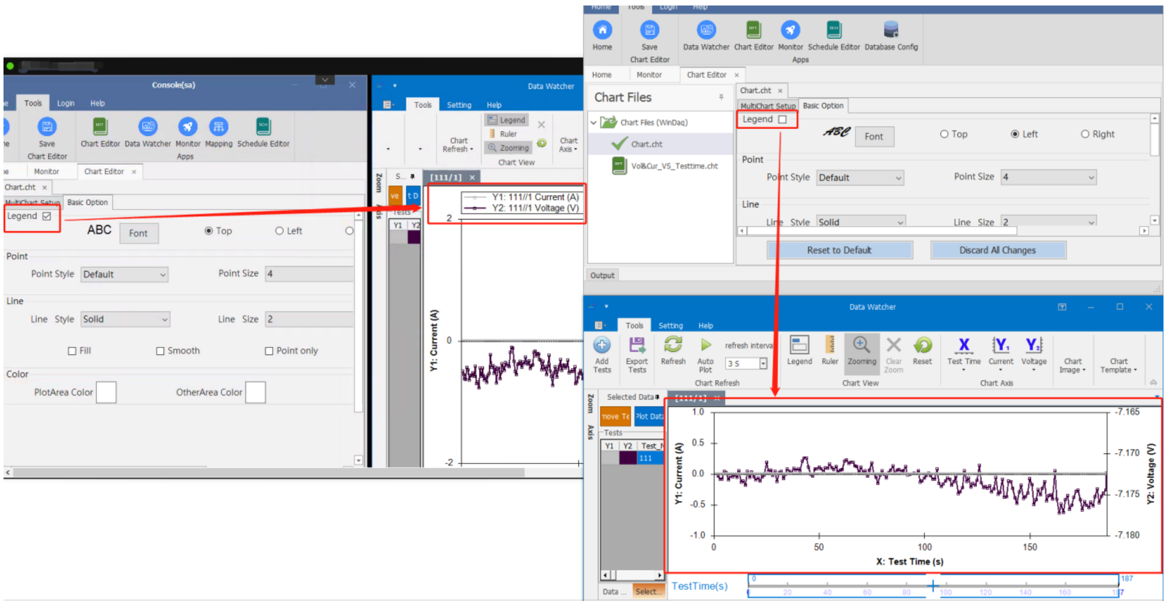


Figure 9-17 Display the Legend

2) **Font** – Sets the font for the Legend text.
3) **Top, Left, Right** – Sets the position for the Legend.

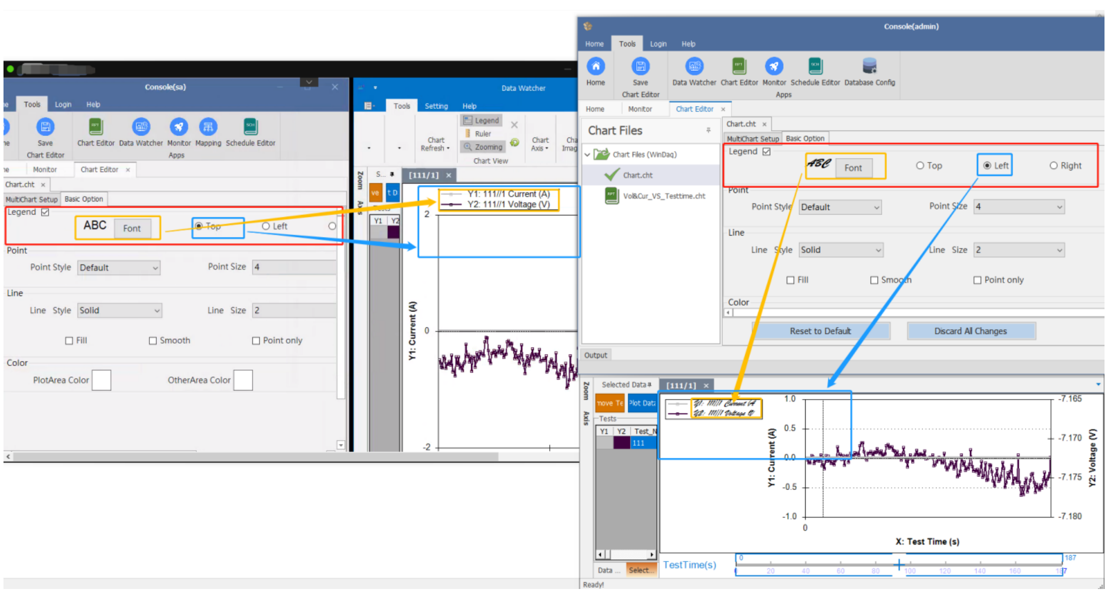


Figure 9-18 Legend Style Settings

Configure Data Point Styles

The "Point" options on the Basic Options Page control the display styles of data points on the chart.

1) **Point Style** – Sets the symbol style for the data points.
2) **Point Size** – Sets the size of the data points.

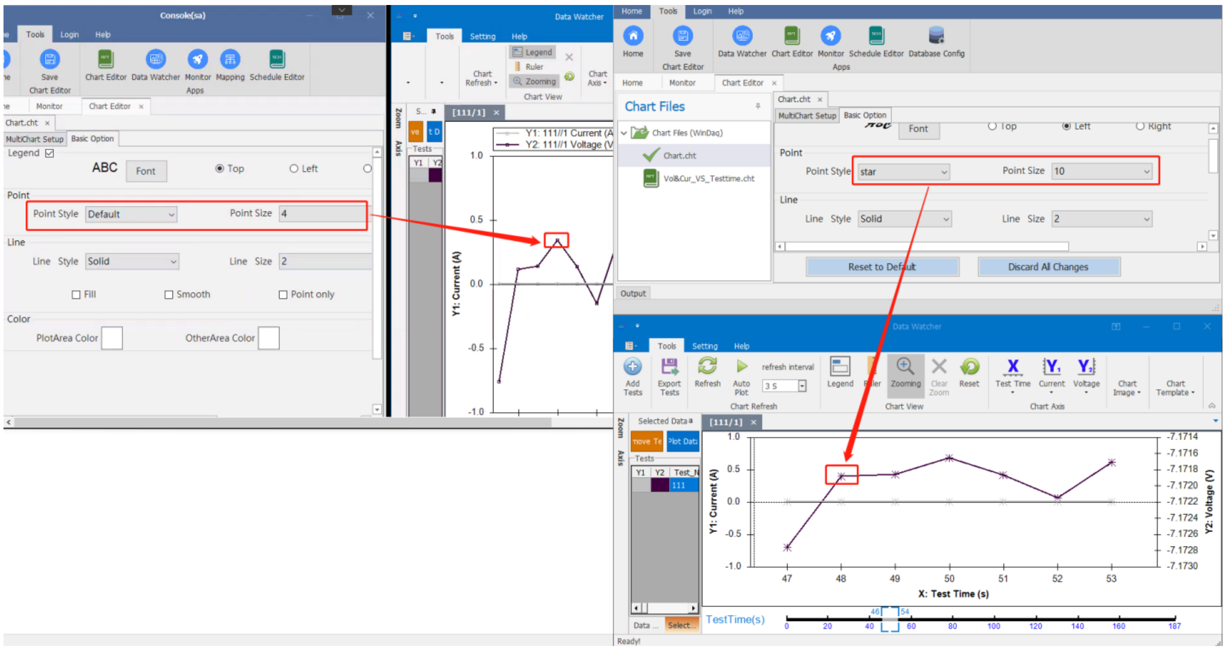


Figure 9-19 Data Point Style Settings

Configure Line Styles

The "Line" options on the Basic Options Page control the display styles of lines on the chart.

1) **Line Style** – Sets the style of the connecting line between data points.

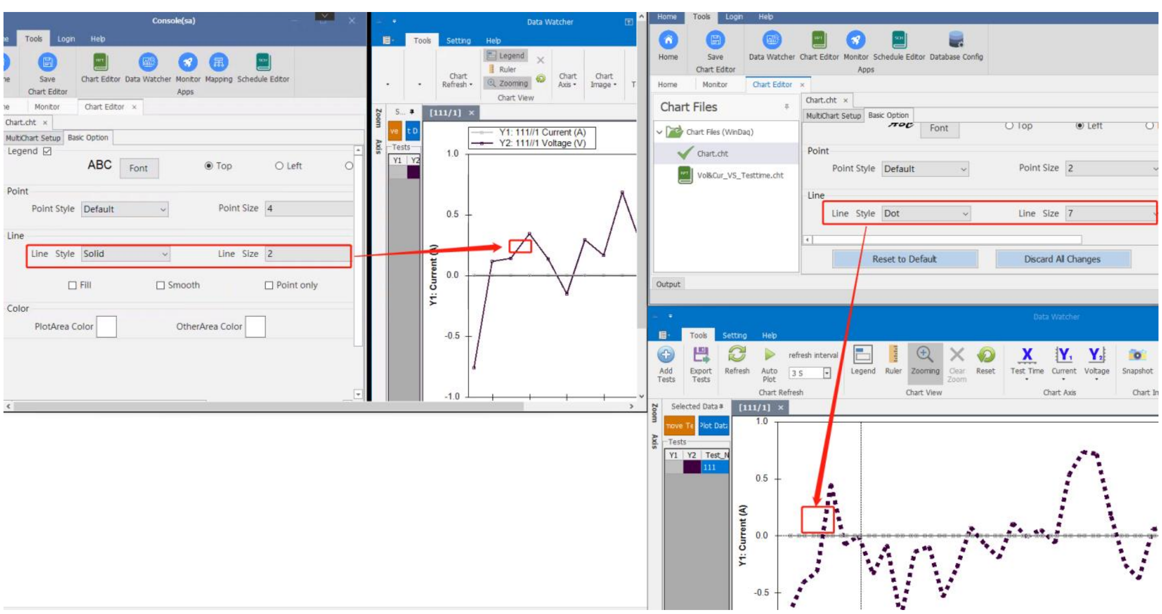


Figure 9-20 Line Style Setting

2) **Line Size** – Sets the thickness of the connecting line.
3) **Fill** – Controls whether the data is filled to the upper edge of the chart.

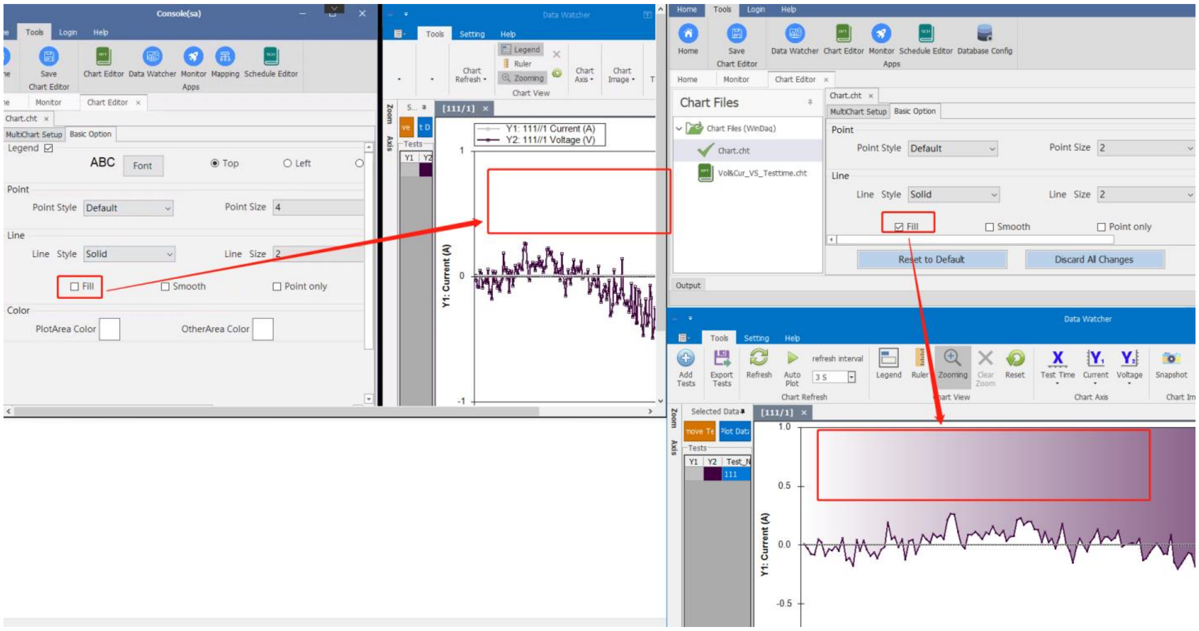


Figure 9-21 Line Fill Setting

4) **Smooth** – Makes the connecting lines between the data points smooth.

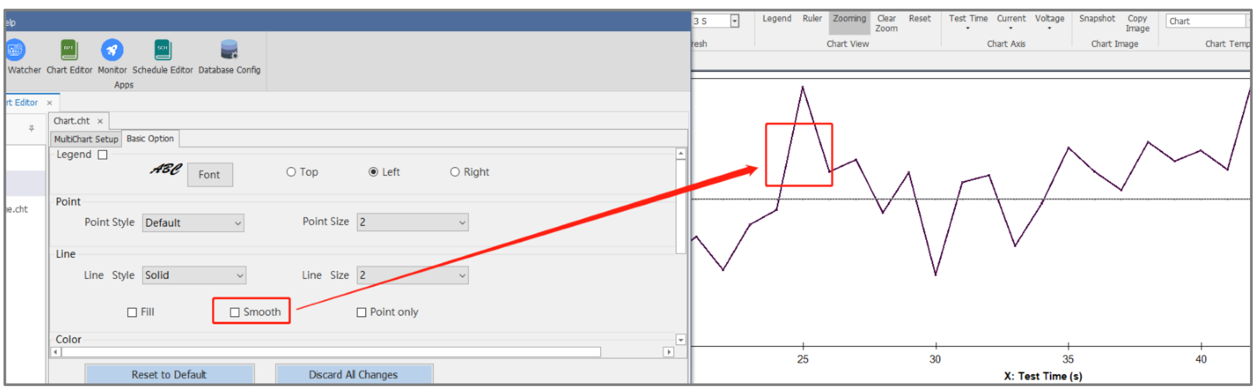


Figure 9-22 Line Display without the Smooth Setting

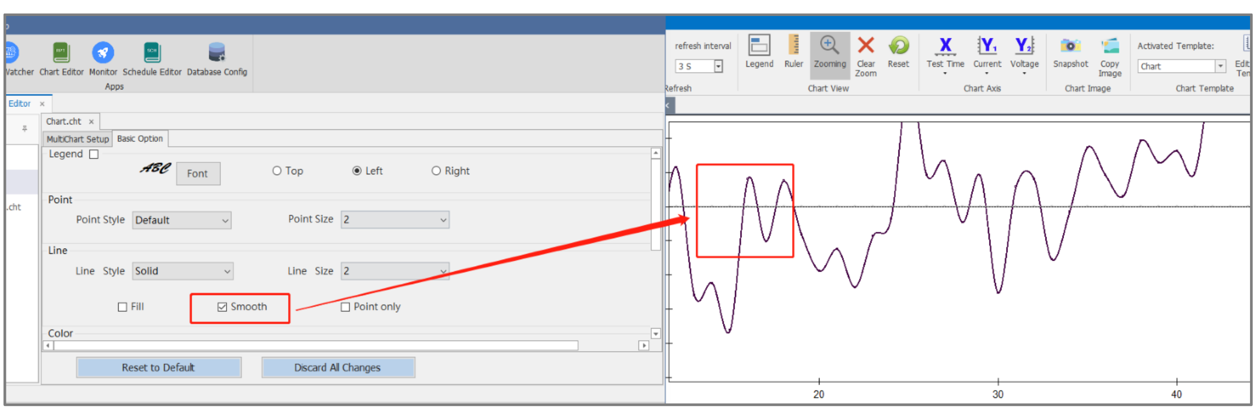


Figure 9-23 Line Display without the Smooth Setting

5) **Point Only** – Controls whether or not a connecting line is displayed between data points.

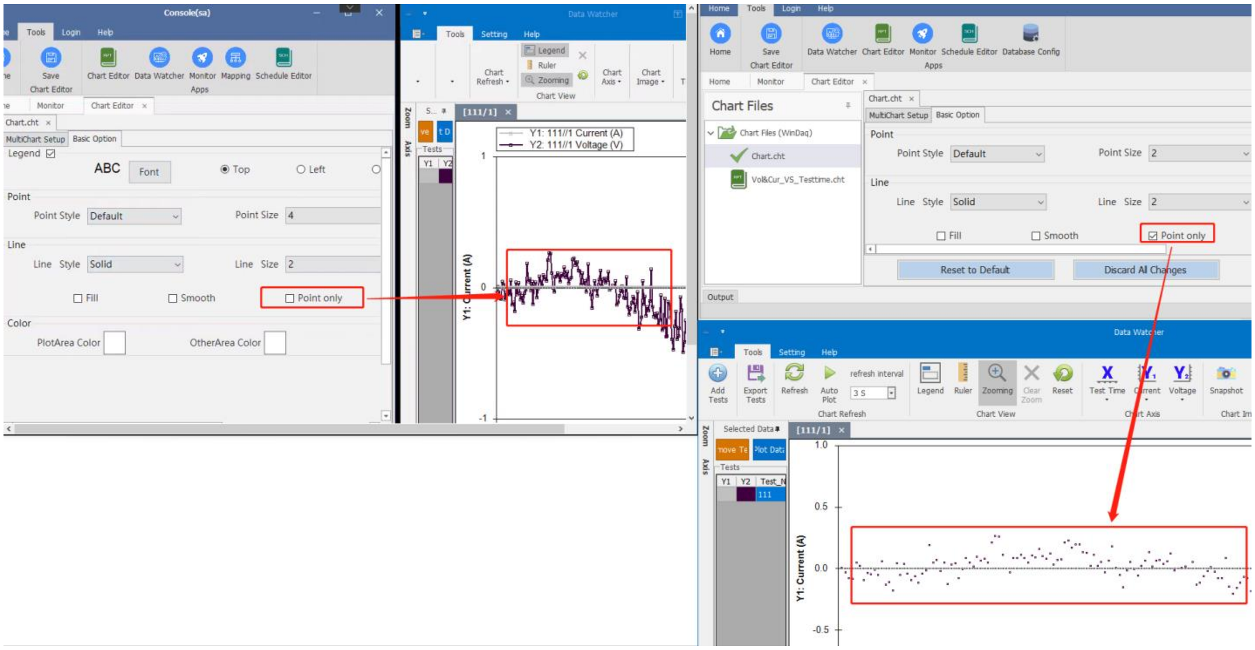


Figure 9-24 Line Display with Point Only Setting

Configure the Chart Background Color

The “Color” option on the Basic Options Page control the background color of a single chart.

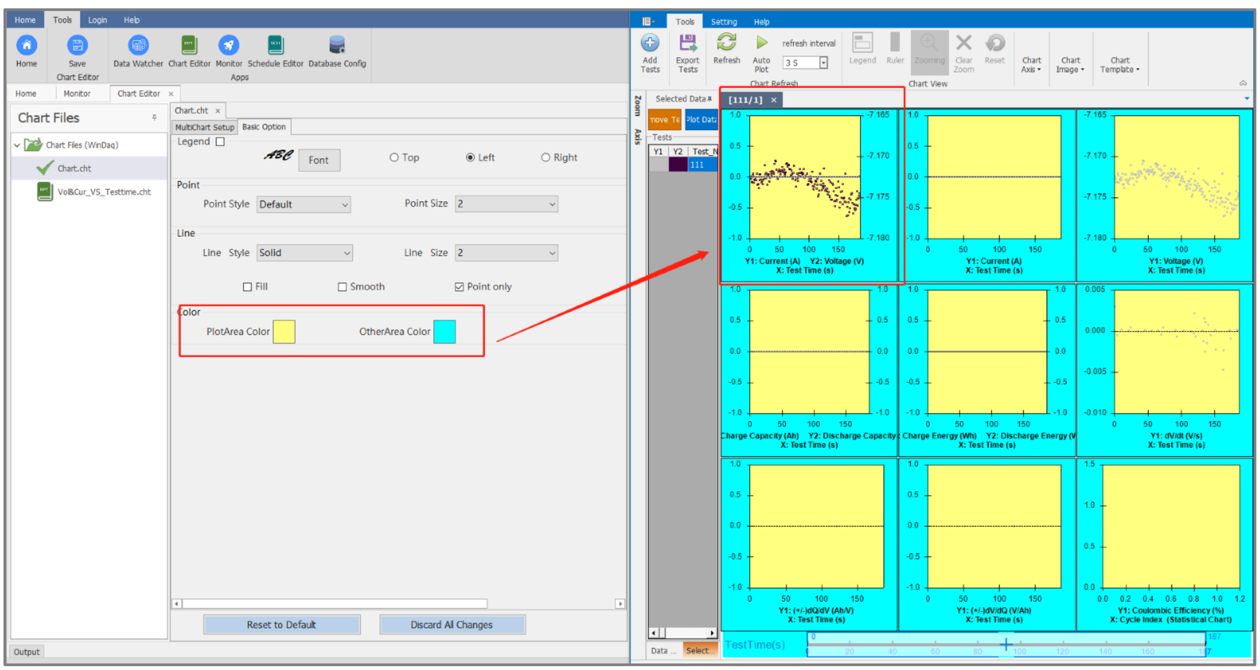


Figure 9-25 Chart Background Color Setting

9.5 Use Chart File Settings in Monitor View

Right-click on the “Chart Setting” label in the Monitor Interface for the following Chart options:

1) **Assign Chart** – Assign a Chart File.
2) **Clear Chart** – Clear a Chart File.
3) **Open Chart** – Open a Chart File.

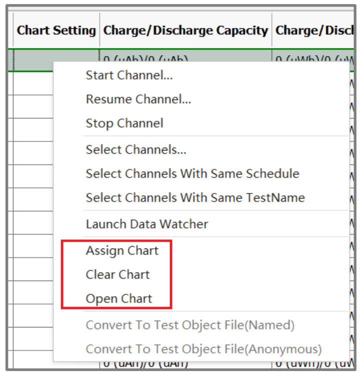


Figure 9-26 Right-Click Menu for Chart Settings in the Monitor DetailView

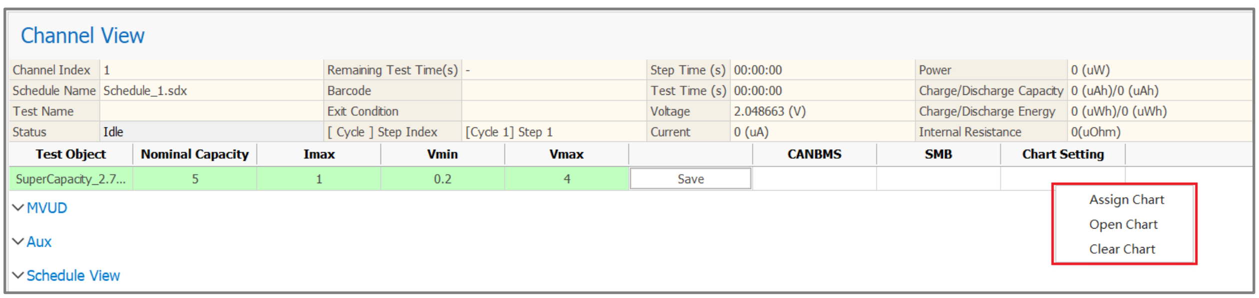


Figure 9-27 Right-Click Menu for Chart Settings in the Monitor Channel View

9.6 Assign a Chart File to a Schedule File

The Vol&Cur_VS_Testtime.cht file is a Chart File created by the system by default; this file is referenced by each Schedule File by default. You can also create a new Chart File and apply it to the Schedule File.

1) Open the Global Page of the Schedule File.
2) Right-click on the display box under the "Data Chart" label.
3) Click on the "Assign File" option from the menu that appears.
4) Navigate to and select the Chart File you want to use in the "Assign Chart" Interface that appears.
5) Click the "OK" button at the bottom of the "Assign Chart" Interface to assign the selected Chart File to the Schedule File.

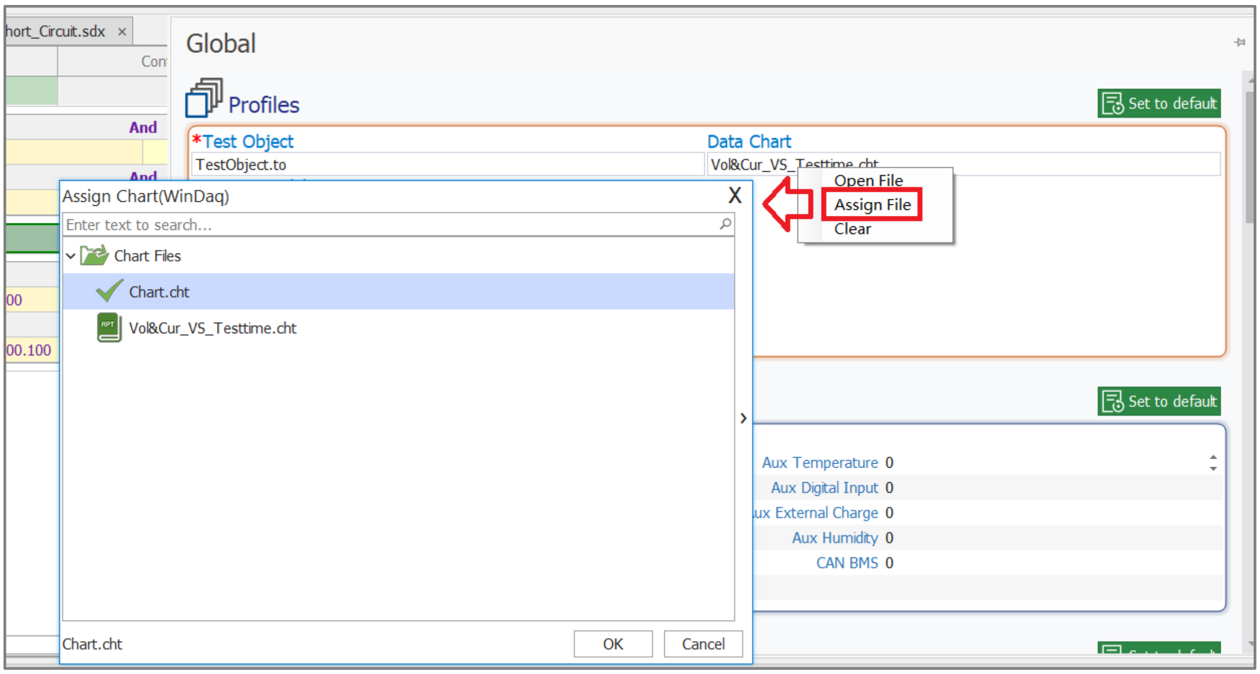


Figure 9-28 Assign a Chart File to the Schedule File

10: The Monitor

10.1 Introduction to the Monitor

10.1.1 What is the Monitor?

The Monitor is the main way to conduct and monitor Tests on channels in Mits X. When the Monitor Page is displayed, the channel data will refresh based on the data refresh rate that is set in the Monitor Options setting.

There are three views in the Monitor: Detail View, Brief View, and Channel View. Tests can be conducted in all three views. By default, the Monitor interface displays Detail View and Channel View side-by-side.

10.1.2 Open the Monitor

1) On the Mits X home screen, double-click on the Monitor icon.

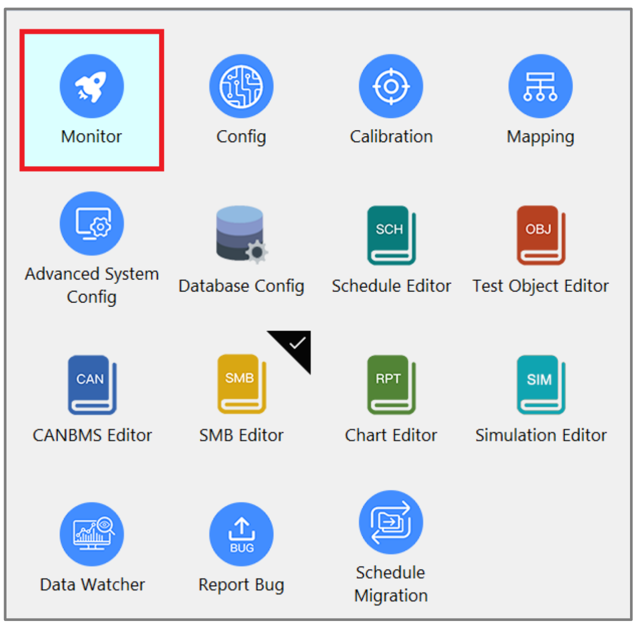


Figure 10-1 Open the Monitor

After you have opened the Monitor, you will see the three main monitor areas: The Toolbar, Detail View, and Channel View. Detail View and Channel View can be switched.

10.1.3 The Monitor Toolbar

Mits X provides the following operation functions in the Monitor Toolbar:

1) **Start** – Start the Test on the channel that you have selected.
2) **Stop** – Stop the Test on the channel that you have selected.
3) **Resume** – Resume the Test on the channel that you have selected.
4) **Continue** – If the selected channel is in a Pause state, continue the Test.
5) **Jump Step** – If the selected channel is in a Test state, jump to a different Step in the Schedule for testing.
6) **Stop All** – Stop all channel Tests.
7) **DataWatcher** – Start the DataWatcher software.
8) **Brief** – Switch the Monitor View mode.
9) **Write CAN BMS Message** – Write CAN BMS broadcast messages.
10) **Options** – Configure the style of the Monitor interface.

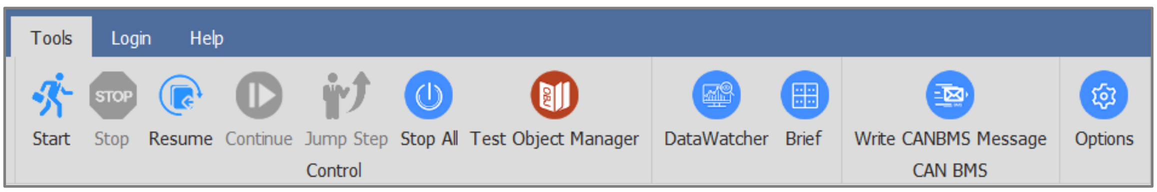


Figure 10-2 The Monitor Toolbar

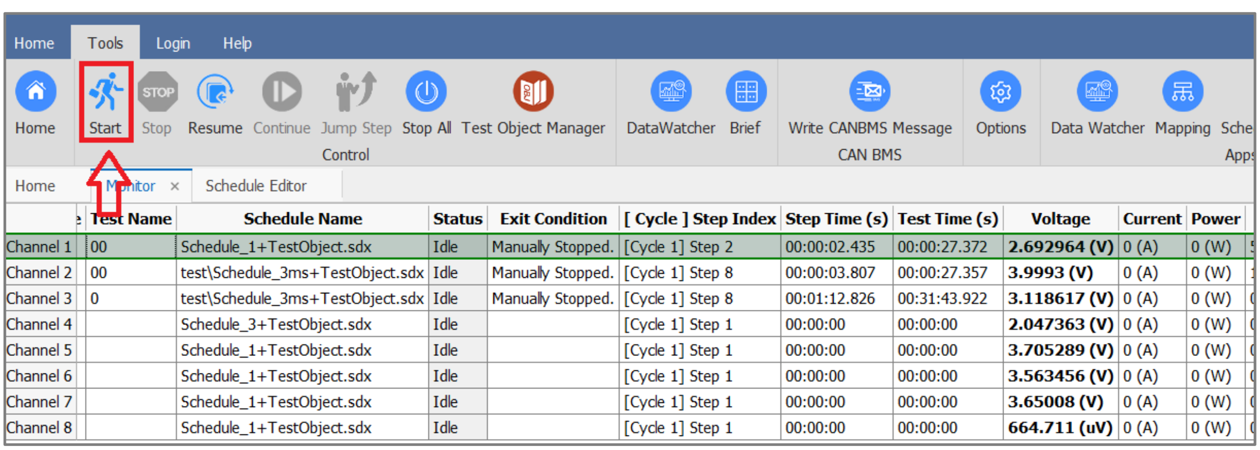
10.2 Manage Channels with the Monitor Toolbar

10.2.1 Start a Channel

Use the “Start” feature to start a test on the selected channel or channels.

Start a Test on a Single Channel

1) Left-click on the name of the channel that you want to start testing.
2) Click on the “Start” icon in the Monitor Toolbar to open the “Start Channel(s)” Interface.



	Test Name	Schedule Name	Status	Exit Condition	[Cycle] Step Index	Step Time (s)	Test Time (s)	Voltage	Current	Power
Channel 1	00	Schedule_1+TestObject.sdx	Idle	Manually Stopped.	[Cycle 1] Step 2	00:00:02.435	00:00:27.372	2.692964 (V)	0 (A)	0 (W)
Channel 2	00	test\Schedule_3ms+TestObject.sdx	Idle	Manually Stopped.	[Cycle 1] Step 8	00:00:03.807	00:00:27.357	3.9993 (V)	0 (A)	0 (W)
Channel 3	0	test\Schedule_3ms+TestObject.sdx	Idle	Manually Stopped.	[Cycle 1] Step 8	00:01:12.826	00:31:43.922	3.118617 (V)	0 (A)	0 (W)
Channel 4		Schedule_3+TestObject.sdx	Idle		[Cycle 1] Step 1	00:00:00	00:00:00	2.047363 (V)	0 (A)	0 (W)
Channel 5		Schedule_1+TestObject.sdx	Idle		[Cycle 1] Step 1	00:00:00	00:00:00	3.705289 (V)	0 (A)	0 (W)
Channel 6		Schedule_1+TestObject.sdx	Idle		[Cycle 1] Step 1	00:00:00	00:00:00	3.563456 (V)	0 (A)	0 (W)
Channel 7		Schedule_1+TestObject.sdx	Idle		[Cycle 1] Step 1	00:00:00	00:00:00	3.65008 (V)	0 (A)	0 (W)
Channel 8		Schedule_1+TestObject.sdx	Idle		[Cycle 1] Step 1	00:00:00	00:00:00	664.711 (uV)	0 (A)	0 (W)

Figure 10-3 Start a Channel

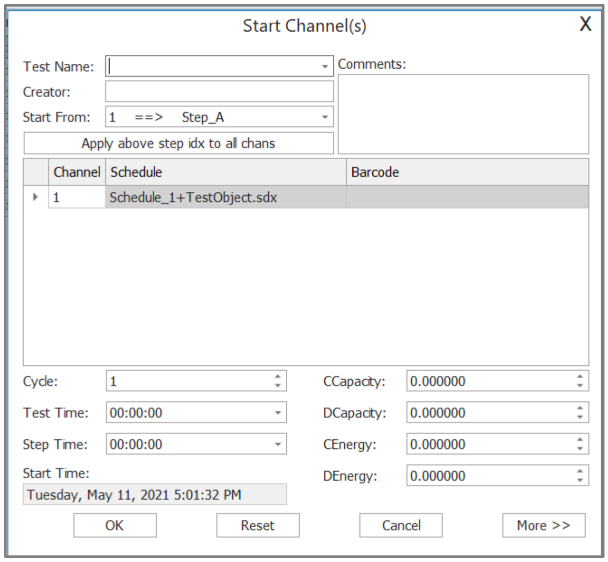


Figure 10-4 Start Channel(s) Interface

3) Complete the Start Channel(s) information.
   a) **Test Name** – Enter the Test name, which will also be the file name for the test data.
      i) Click on the small triangle icon on the right side of the input box to select a name from all the existing file names.
      ii) Move the cursor to the input box and roll the mouse wheel to scroll through and select a name from all existing file names.

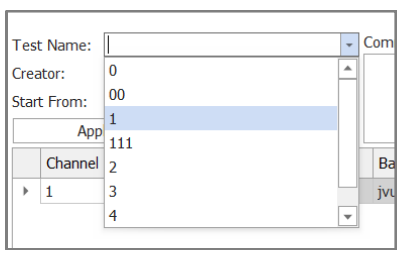


Figure 10-5 Enter a Test Name

   b) **Creator** – The person who initiated the Test (optional).
   c) **Comments** – Any description or notes for the Test (optional).
   d) **Start From** – Select the Step to start the Test.
      i) The default value is the first Step of the Schedule.
      ii) Click on the small triangle icon on the right side of input box to select a Step from the full list.

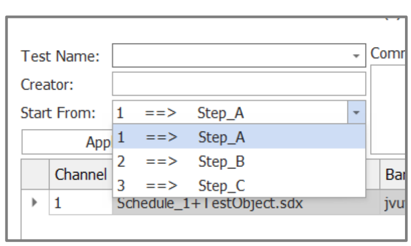
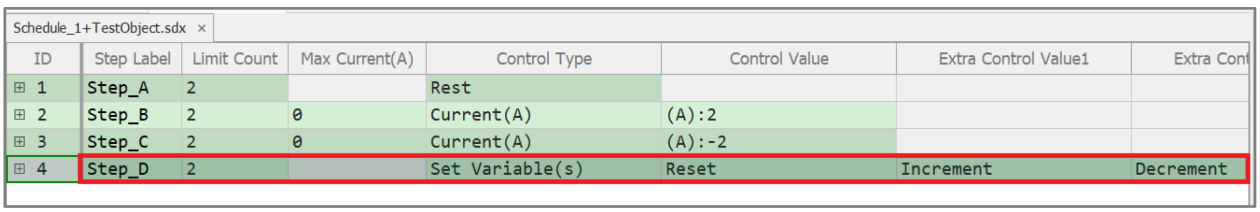


Figure 10-6 Select the Step to Start the Test

e) Select the first Step of the Schedule for all selected channels (if not Step 1).
   i) When selecting multiple channels to start at the same time, after selecting the Step to start the text, click the “Apply Above Step Index to All Channels” button. This will make all channels start the Test from the selected Step.
   ii) If “Apply Above Step Index to All Channels” is not used, the ‘Start From” Step is only applied to the first channel.
f) **Channel (and Schedule):** Display the start test Channel Index and its Schedule.
   i) If multiple channels are started at the same time, it will display all channel numbers and their Schedules.
   ii) You can set the Barcode of the channel in the input box below the Barcode label.
g) **Cycle:** Input the initial cycle number of the Test (default value is 1).
   i) Input the value directly or click on the small triangle icon on the right side of the input box to select the value.
   ii) If the Cycle Control Type is set in the Schedule assigned by the current channel, the initial cycle number of the Test set here will take effect. Otherwise, the setting will not take effect.


Schedule_1+TestObject.sdx ×

ID	Step Label	Limit Count	Max Current(A)	Control Type	Control Value	Extra Control Value1	Extra Cont
1	Step_A	2		Rest			
2	Step_B	2	0	Current(A)	(A):2		
3	Step_C	2	0	Current(A)	(A):-2		
4	Step_D	2		Set Variable(s)	Reset	Increment	Decrement

Figure 10-7 Schedule Cycle Step

h) **Test Time** – Set the start value of the Test time.
i) **Step Time** – Set the start value of the Step time.
j) **Start Time** –Show the start of the Test.
k) **CCapacity and Dcapacity** – Set the initial value of charge and discharge capacity; default initial values are 0.
l) **CEnergy and Denergy** – Set the initial value of charging and discharging energy; default initial values are 0.
m) **Reset** – Reset all capacity/energy and Test-related values.

4) Click "More" to display additional settings.

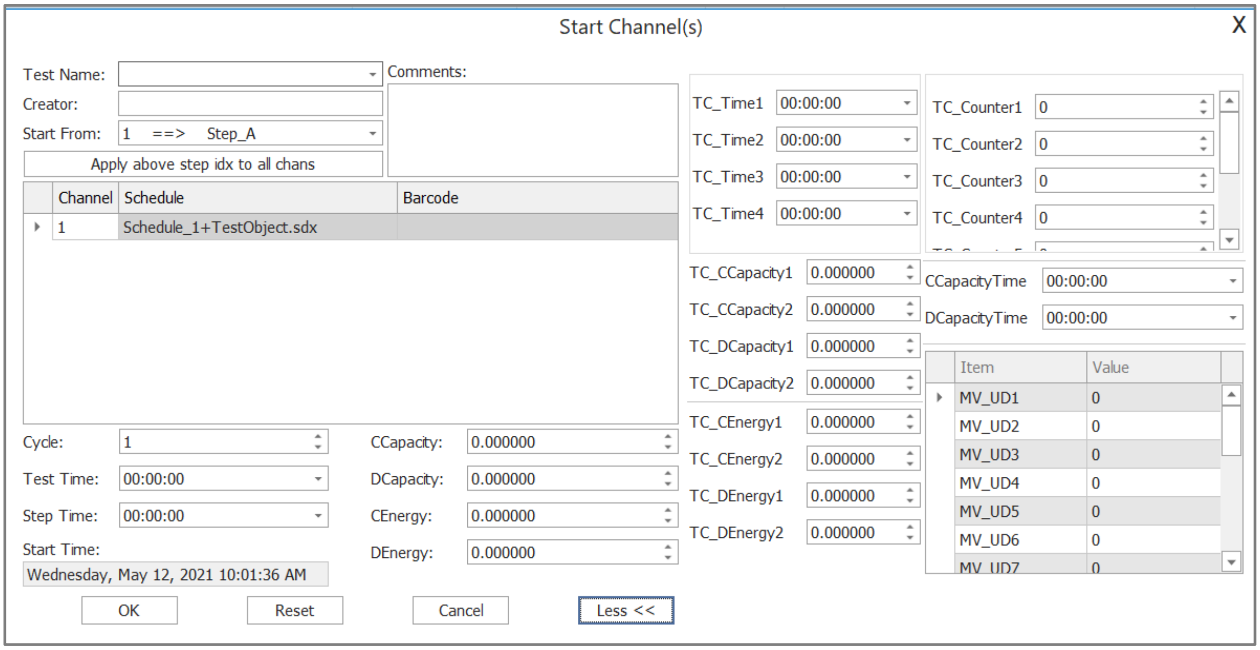


Figure 10-8 Show More Settings

a) **TC_Counter** – The initial value of the Test Counter.
   i) The Test Counter includes a test time counter, a charge capacity counter, a discharge capacity counter, a charge energy counter, and a discharge energy counter.
   ii) The default initial value of these counters is 0 (00:00:00).
b) **CCpacityTime** – Charging capacity time.
c) **DCapacityTime** – Discharge capacity time.
d) **MV_UD** – User-defined meta variables.
   i) After the MV_UD value is set, it will be displayed in the Channel View during the Test.
   ii) In addition, when the MU_UD value is set in the Schedule selected by the current channel, it will also be displayed in this Interface.

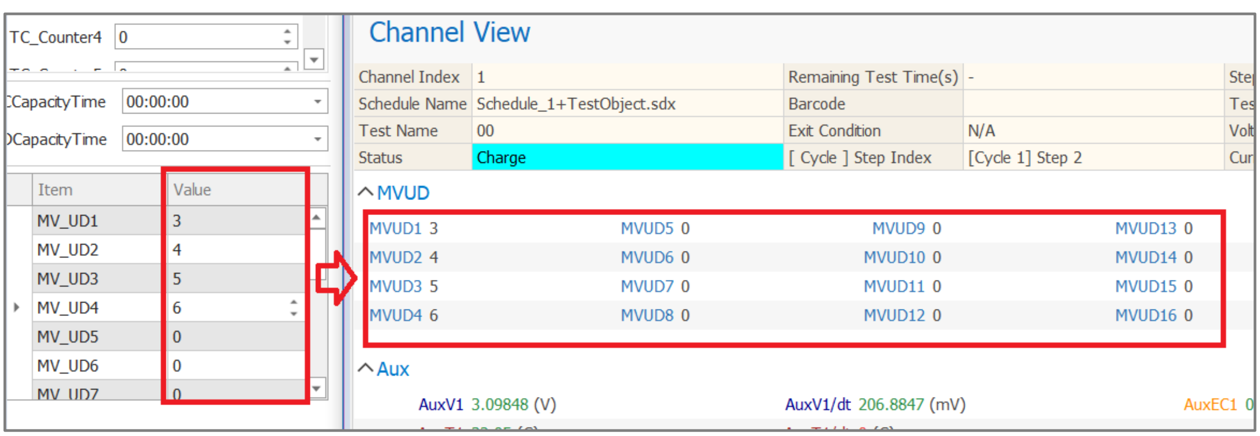


Figure 10-9 MV-UD Value Displayed in Channel View

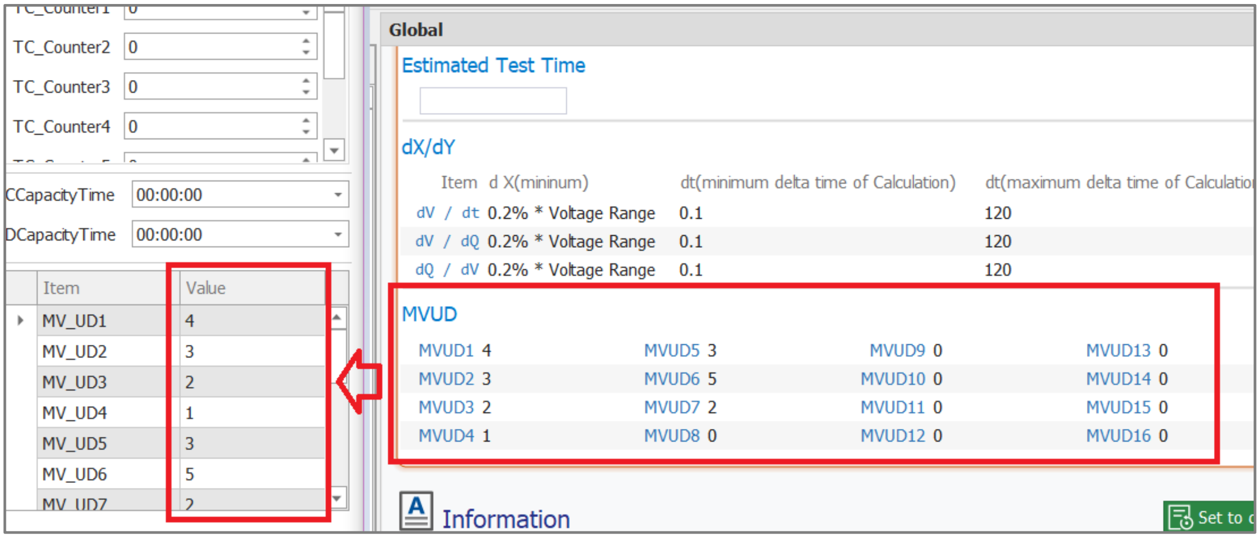


Figure 10-10 MV-UD Value Displayed in the Start Channel Interface

5) After completing the above settings, click the “OK” button at the bottom of the Start Channel(s) Interface to start the Test.

Start Testing on Multiple Channels Simultaneously

1) Left-click and drag to select all of the channels you want to start testing at the same time.
2) Click on the “Start” icon in the Monitor Toolbar to open the “Start Channel(s)” Interface.

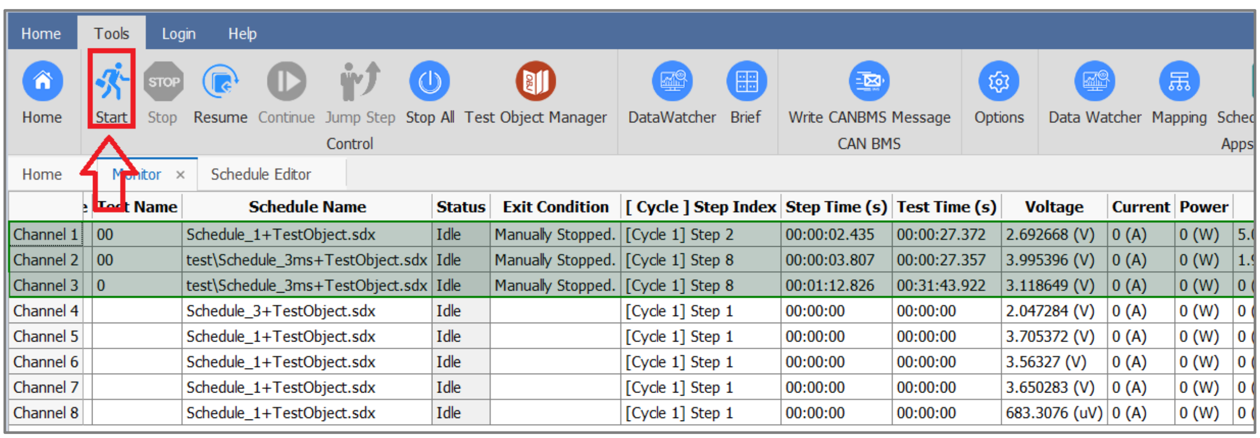


Figure 10-11 Start Multiple Channels at the same time.

3) Click the table to switch channels to set channel information.

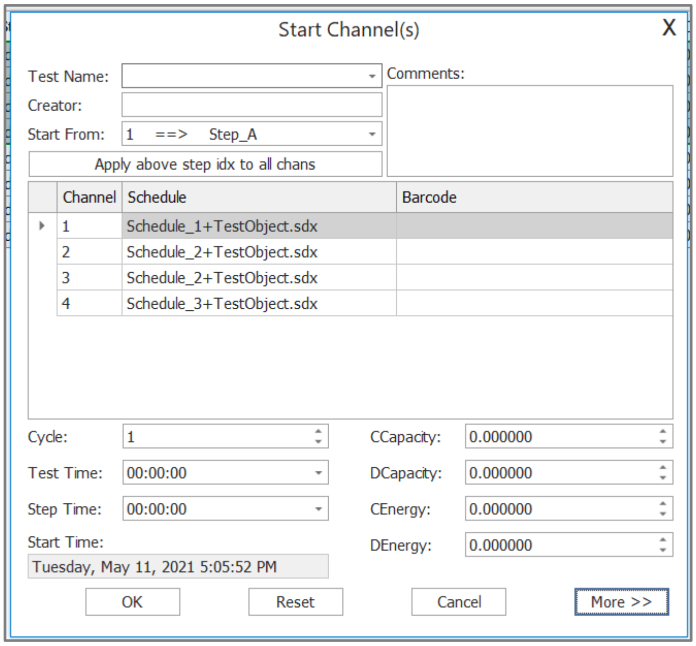


Figure 10-12 Start Channel(s) Interface for Multiple Channels

In the Monitor, if the recorded data file reaches the maintenance size limit set in System Configuration (cluster), a warning message will display in the Hints field at the bottom of the Monitor Interface. To start more channels, you will be reminded to reduce the file size by repairing and compressing, deleting, or exporting data before starting other Tests.

10.2.2 Stop a Channel

Use the “Stop” feature to stop the test on the selected channel or channels.

Stop a Test on a Single Channel

1) Left-click on the name of the channel that you want to stop testing.
2) Click on the “Stop” icon in the Monitor Toolbar to stop the channel.

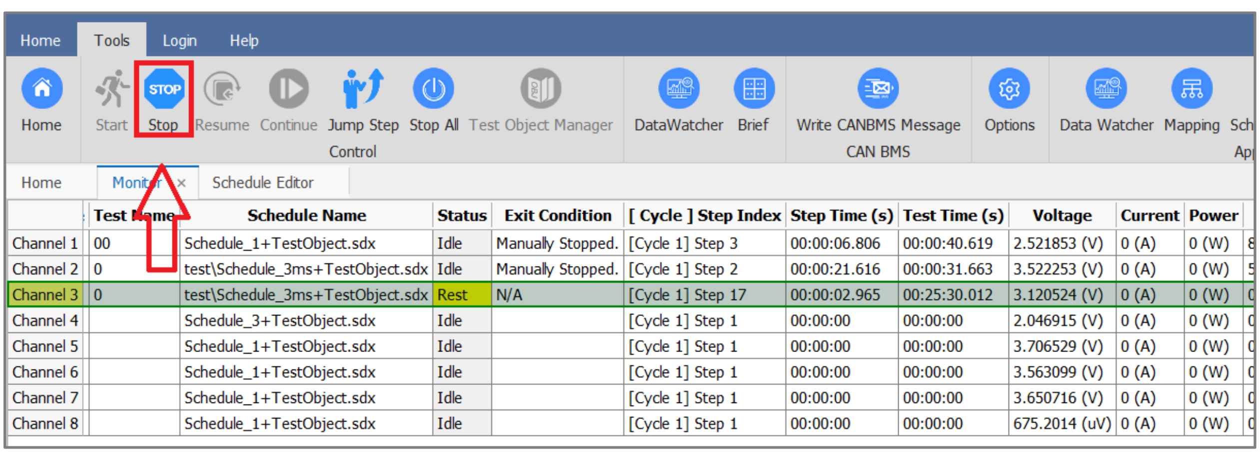


Figure 10-13 Stop a Channel

Stop Testing on Multiple Channels Simultaneously

1) Left-click and drag to select all of the channels you want to stop testing at the same time.
2) Click on the "Stop" icon in the Monitor Toolbar to stop the selected channels.

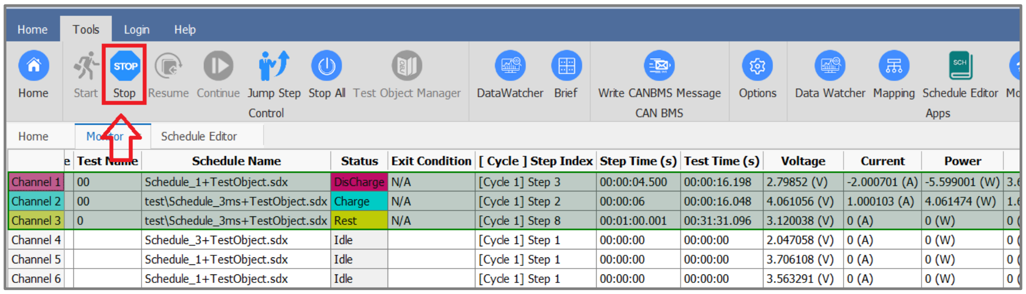


Figure 10-14 Stop Multiple Channels at the Same Time

10.2.3 Resume a Test

Use the "Resume" feature to resume a channel test at the position where the channel test was stopped.

Resume a Test on a Single Channel

1) Left-click on the name of the channel that you want to resume testing.
2) Click on the "Resume" icon to open the "Resume Channel(s)" Interface.

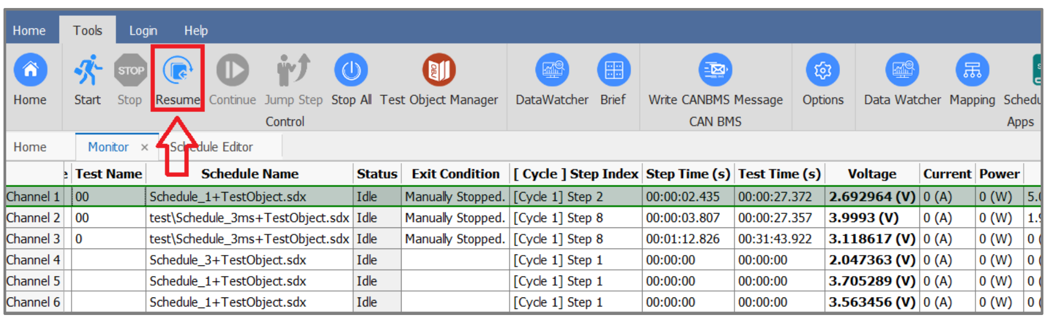


Figure 10-15 Resume Test on a Single Channel

3) Modify or reset (clear all information) in the "Resume Channel(s)" Interface.

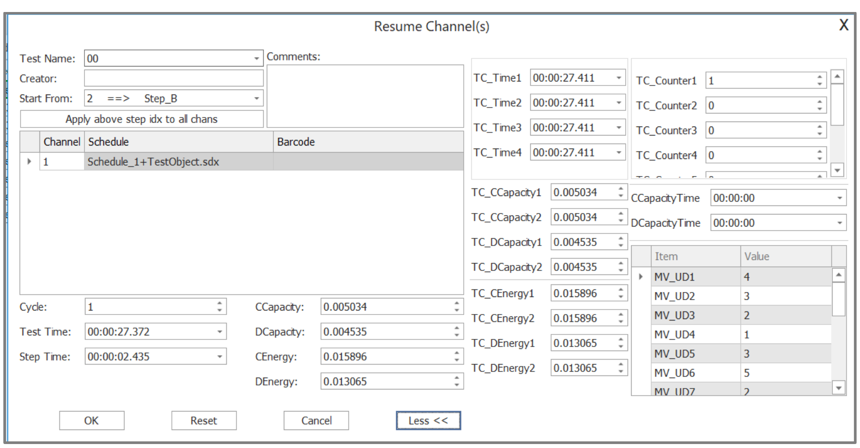


Figure 10-16 The Resume Channel(s) Interface

4) Click the “OK” button at the bottom of the Resume Channel(s) Interface to resume the test on the selected channel.

Resume Testing on Multiple Channels Simultaneously

1) Left-click and drag to select all of the channels you want to resume testing at the same time.
2) Click on the “Resume” icon in the Monitor Toolbar to open the “Resume Channel(s)” Interface.

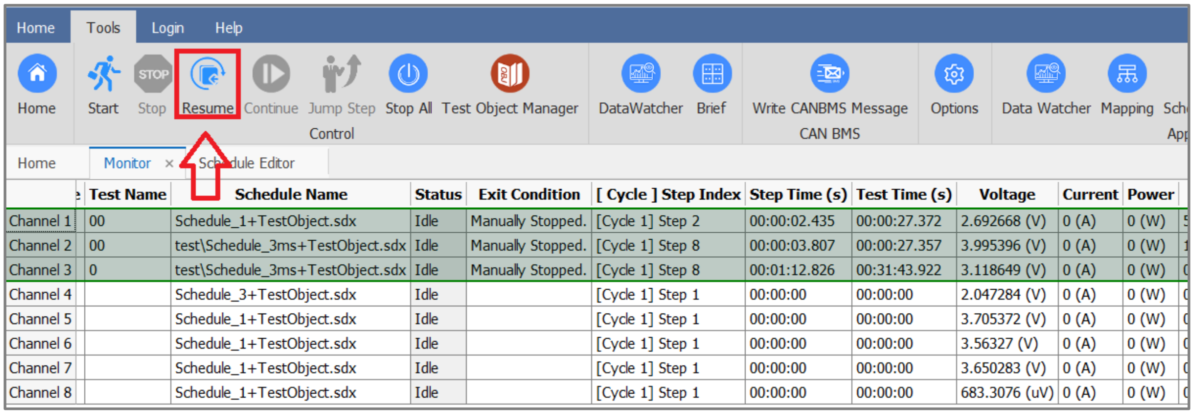


Figure 10-17 Resume Test on Multiple Channels

3) Click on the different channels to view and modify the information for each channel.
4) Click “OK” at the bottom of the “Resume Channel(s)” Interface to resume the test.

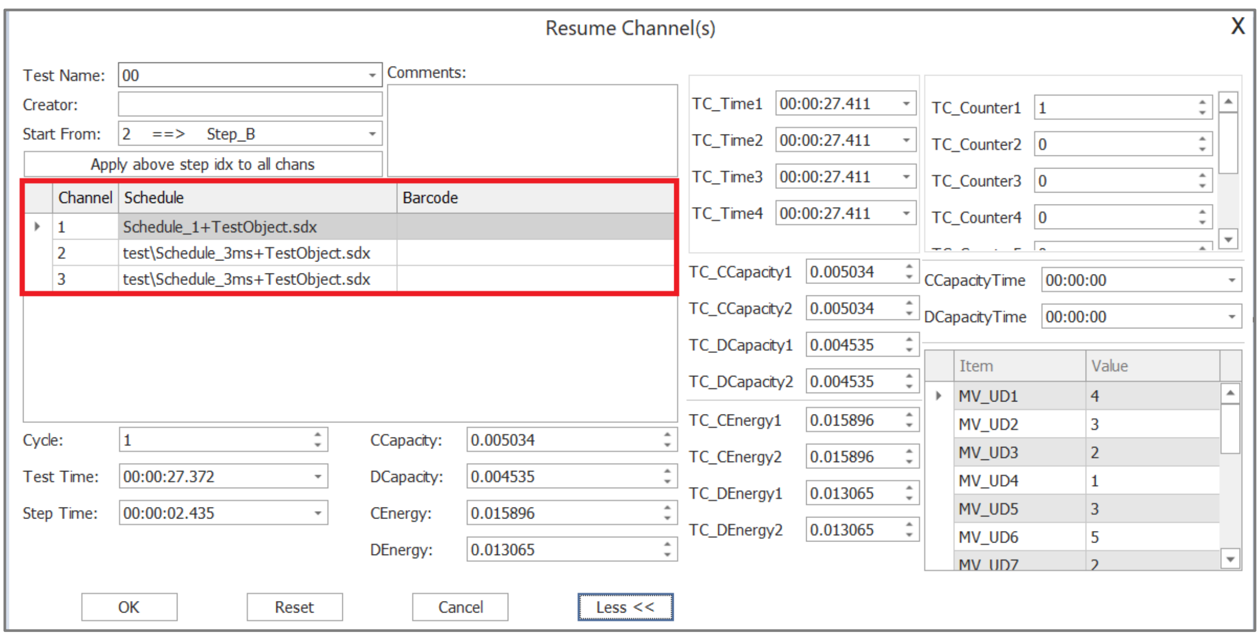


Figure 10-18 Resume Channel(s) Interface for Multiple Channels

10.2.4 Continue a Test

Use the “Continue” feature to continue to test a selected channel that is in a “Pause” state. If the “Pause” Control Type is selected in the Schedule, when the test reaches the Pause Step, the test will enter a pause. At this time, no data will be recorded, and the channels will be closed.

1) Left-click the name of the paused channel that you want to continue to test.
2) Click the “Continue” icon in the Monitor Toolbar to continue the test on the selected channel from the paused point.

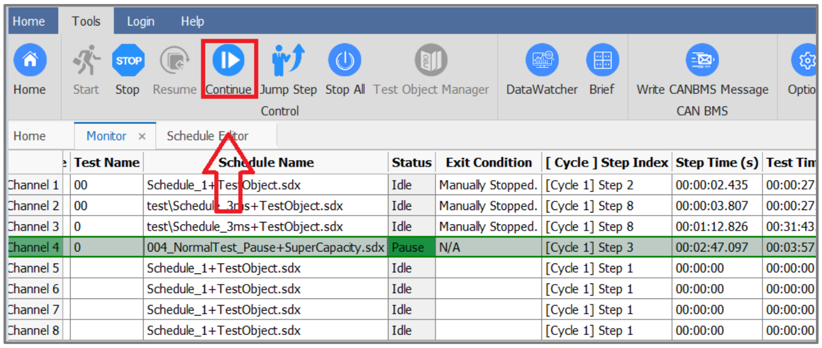


Figure 10-19 Continue Testing

10.2.5 Jump to a Different Step in the Test Schedule

Use the “Jump Step” feature to jump to a new Step in the Schedule.

Jump a Single Channel to a Different Test Step

1) Left-click the name of the channel that you want to jump to another Step.
2) When the selected channel is being tested, click the “Jump Step” icon in the Monitor Toolbar to open the “Jump Step” Interface.
3) Click the Step input box to select the Step you want to jump to from the drop-down list.
4) Click the “OK” button at the bottom of the “Jump Step” Interface to jump the selected channel to the selected Step.
5) If the Step involves a loop, the channel will jump to the next loop.

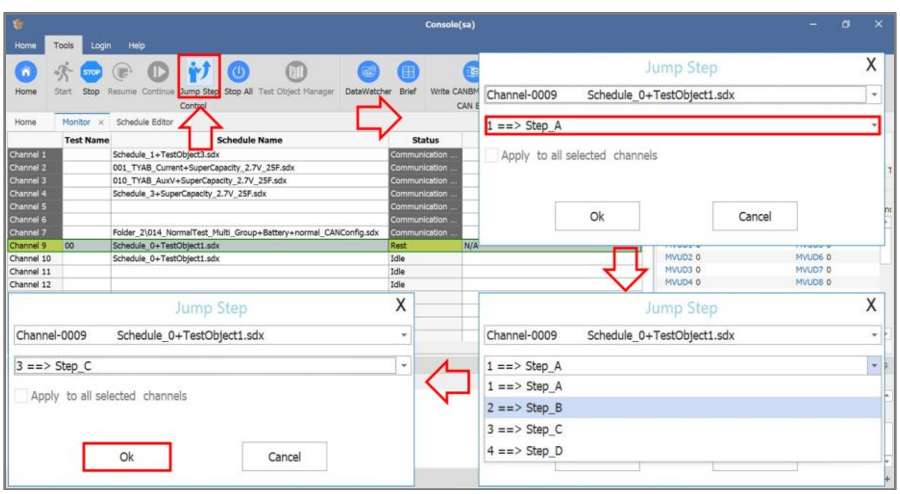


Figure 10-20 Jump a Single Channel

Jump Multiple Channels to a Different Test Step

1) Jump selected channels to the same Step.
   a) Left-click and drag to select the channels you want to jump to another Step.
   b) When the selected channels are being tested, click the “Jump Step” icon in the Monitor Toolbar to open the “Jump Step” Interface.
   c) Click the Step input box to select the step you want to jump to from the drop-down list.
   d) Click the “OK” button at the bottom of the “Jump Step” Interface to jump the selected channels to the selected Step.

NOTE: The number of Steps here is based on the Schedule with the least number of Steps.

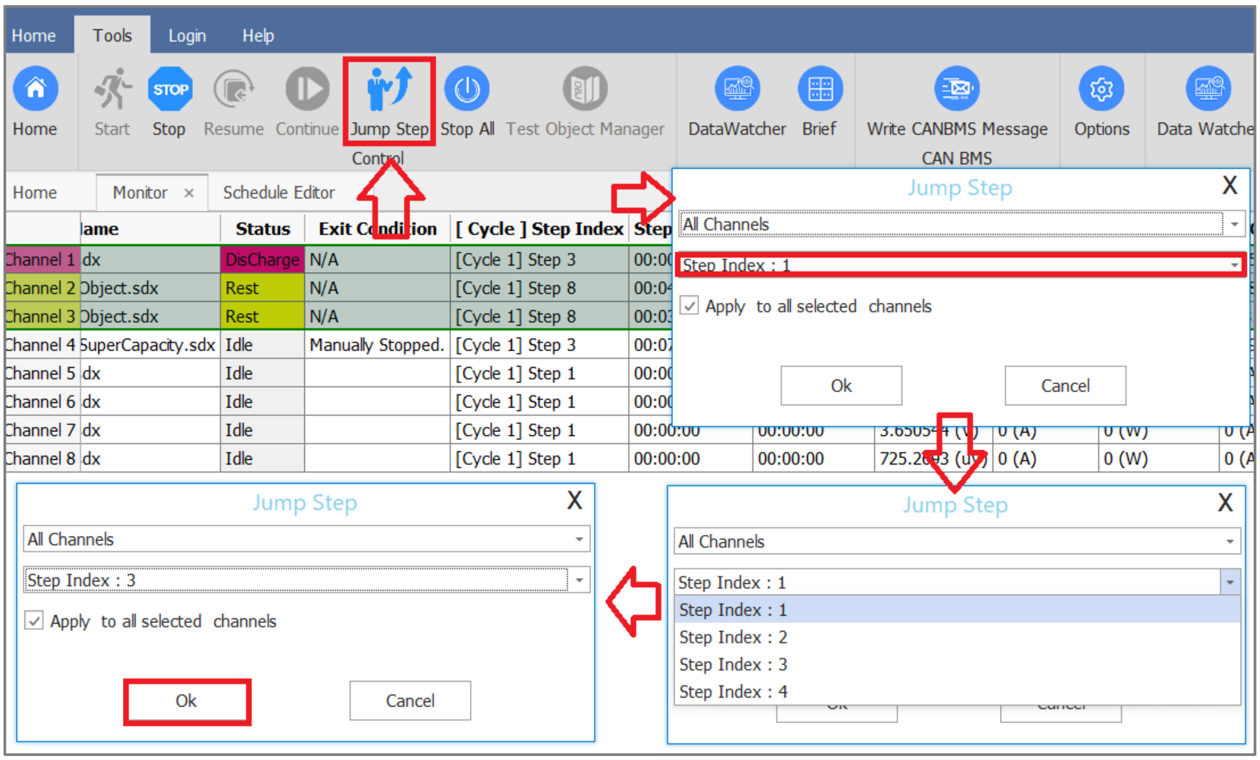


Figure 10-21 Jump Multiple Channels to a Single Step

2) Set the jump of each channel separately.
   a) Left-click and drag to select the channels you want to jump to another Step.
   b) When the selected channels are being tested, click the “Jump Step” icon in the Monitor Toolbar to open the “Jump Step” Interface.
   c) Click the checkmark box to uncheck the “Apply to All Selected Channels” option.
   d) Click the Channel input box, select a channel from the drop-down list and click the Step input box to select the Step you want to jump the channel to from the drop-down list.
   e) Repeat the previous step for each channel that you want to jump.
   f) Click the “OK” button at the bottom of the “Jump Step” Interface to jump the selected channels to the selected steps.

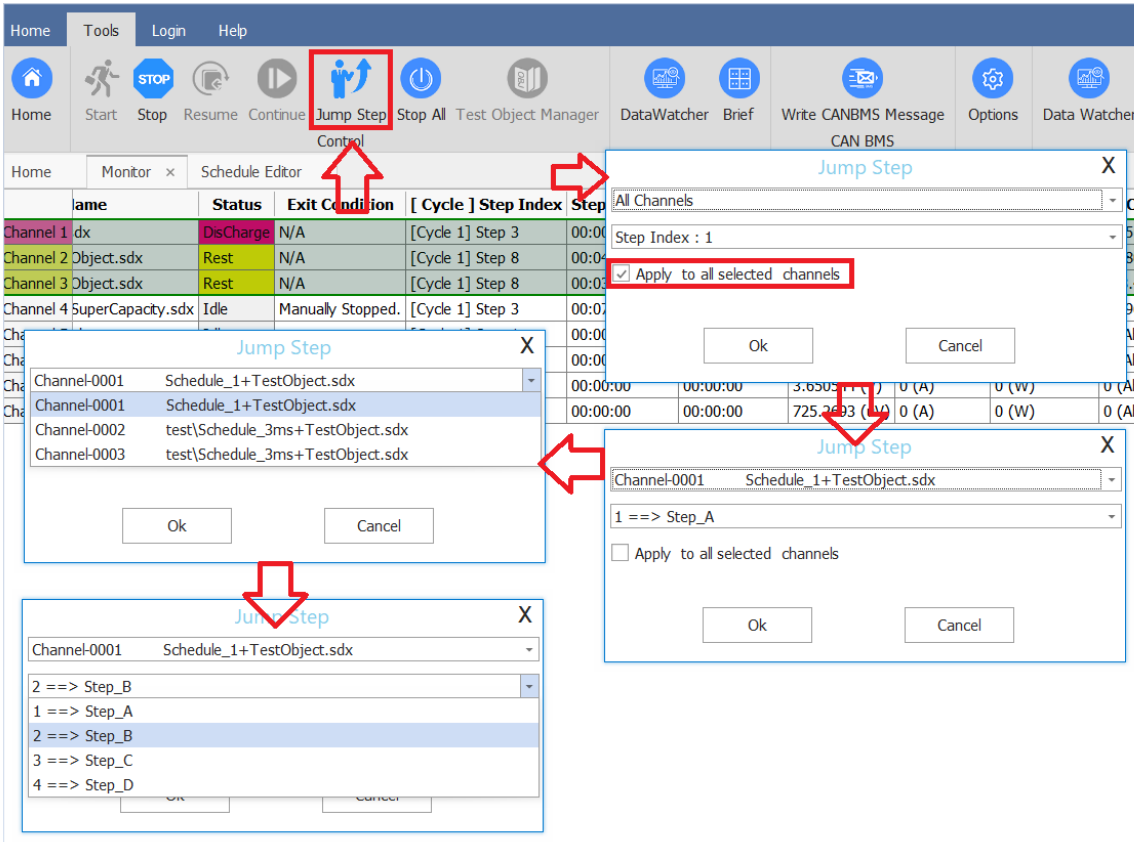


Figure 10-22 Jump Multiple Channels to Different Steps

10.2.6 Stop Testing on All Channels

Use the “Stop All” feature to stop all channel tests.

1) Click on the “Stop All” icon the Monitor Toolbar.
2) Click the “Yes” button in the pop-up box that appears to stop testing on all channels.

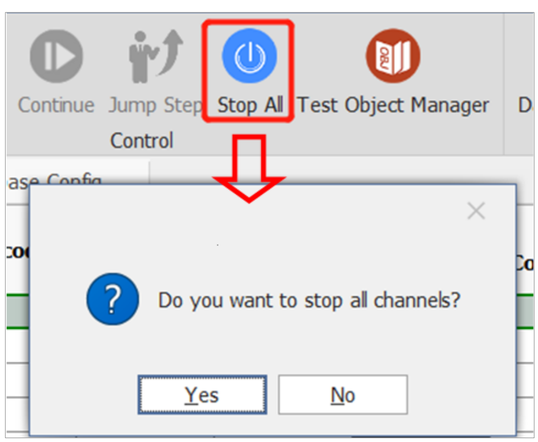


Figure 10-23 Stop Testing on All Channels

10.2.7 Manage Test Object Settings

The Test Object Settings allow you to edit the Test Object File data, update data to the original Test Object File, and edit Anonymous Test Object parameters.

1) The Toolbar for Test Settings contains the Edit View, Save, and Reference Settings.
   a) Edit View:
      i) The Edit View section includes checkmark boxes for: Test Object, Vmax, Nominal Capacity, CANBMS, Imax, SMB, Vmin, Chart Setting, and Save All.
      ii) Any items that are checked in this Toolbar will be displayed in the Detail/Channel Views.
   b) Save: The Save section sets the action that will be performed when the Save button is used.
      i) **Always Overwrite Original** – Always overwrite the original Test Object File.
      ii) **Always Save As New Test Object** – Always save as another new Test Object File.
      iii) **Always Save Anonymous** – Always save as an anonymous Test Object File.
      iv) **Ask Me EveryTime** – A pop-up box will prompt you to choose how you want to save the Test Object File.
   c) Reference Setting:
      i) **Save Contents To Test Setting Files (.tsc) When Test Starts** – Check this option to save the modified Schedule information to the Test Setting File.

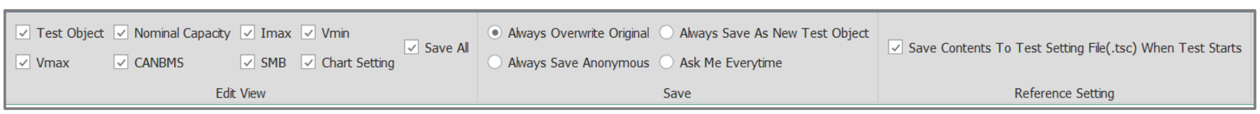


Figure 10-24 Test Object Related Buttons on Toolbox

2) In the Options setting, the display settings for AutoCalculate, Mass, Specific Capacity, Nominal IR, Nominal Voltage, and Nominal Capacitance information are added to the toolbar.

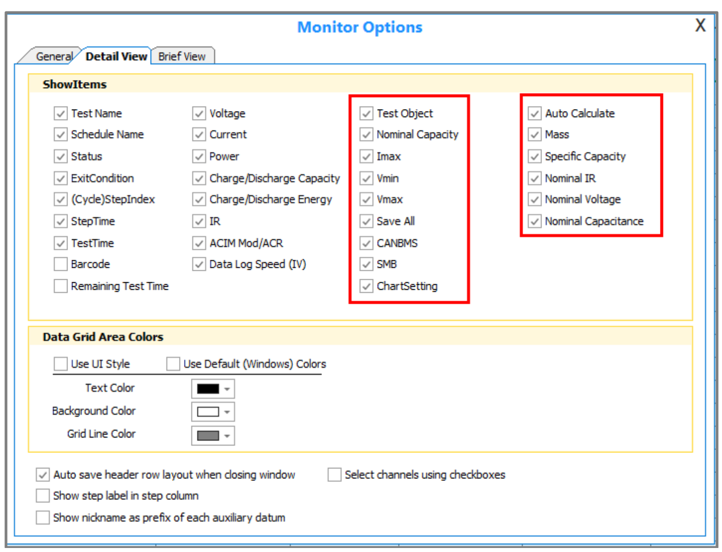


Figure 10-25 Test Object Monitor Options

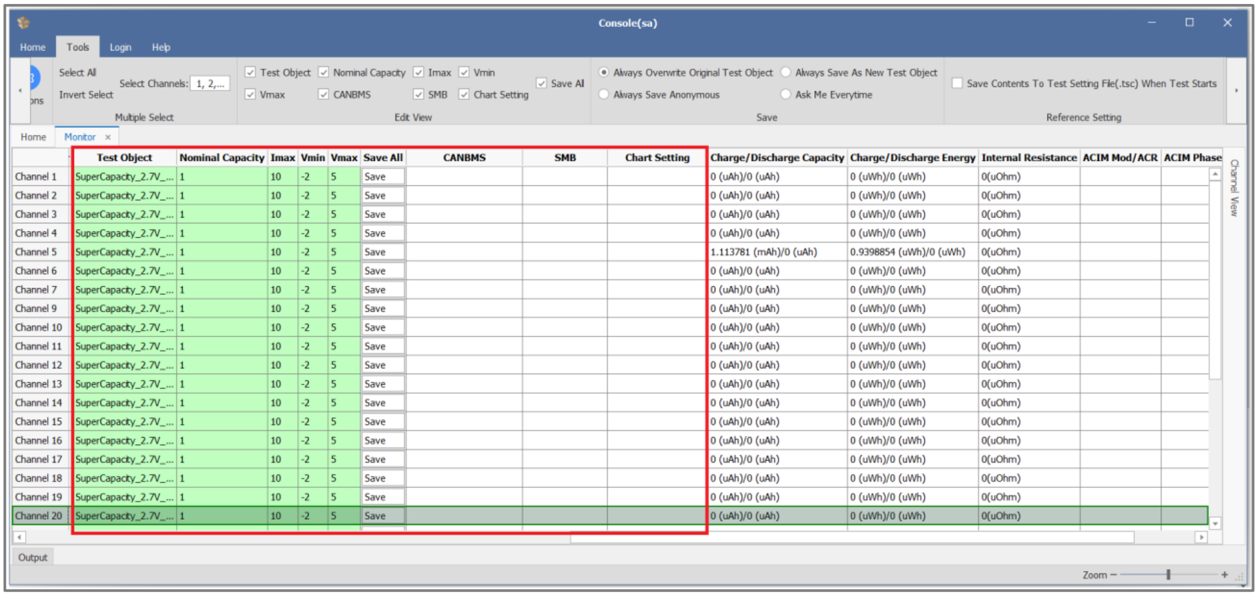


Figure 10-26 Test Object in Detail View

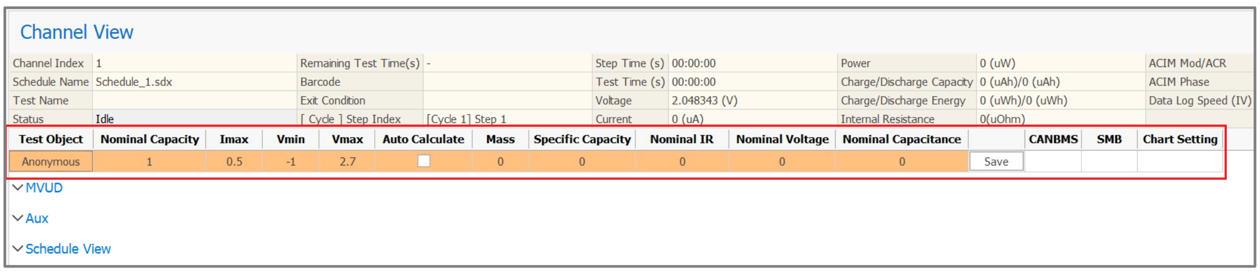


Figure 10-27 Test Object in Channel View

3) Right-click the Test Object name under the Test Object File field to select:
   a) Assign Test Object.
   b) Clear Test Object.
   c) Open Test Object.
   d) Use Last Test Object File (Named).
   e) Convert to Test Object File (Anonymous).

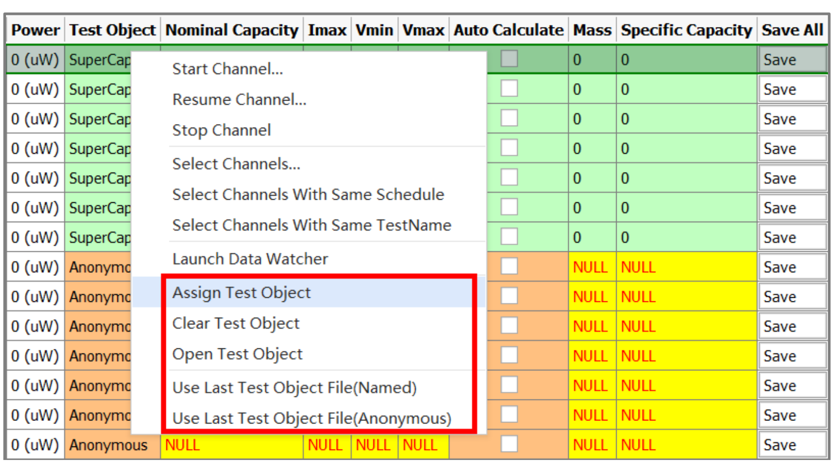


Figure 10-28 Test Object Right-Click menu in Detail View

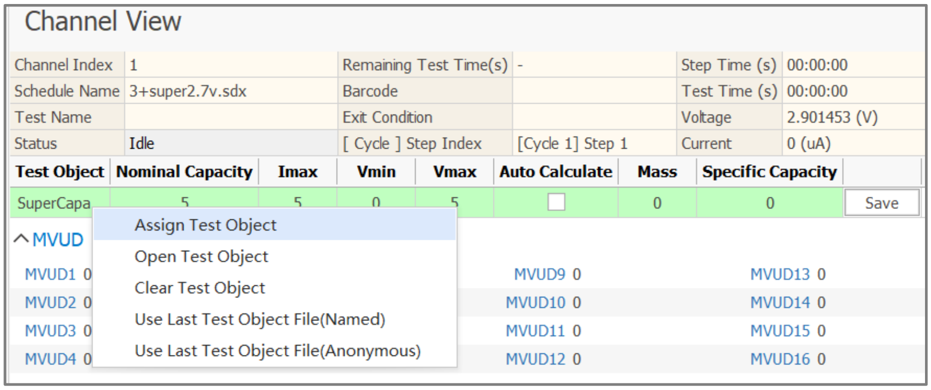
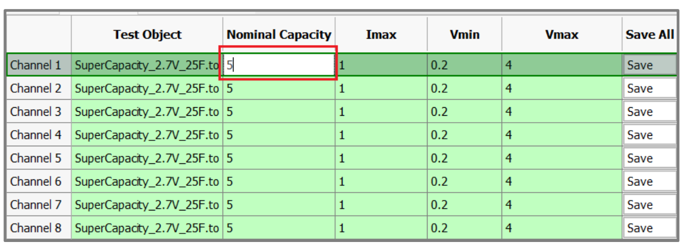


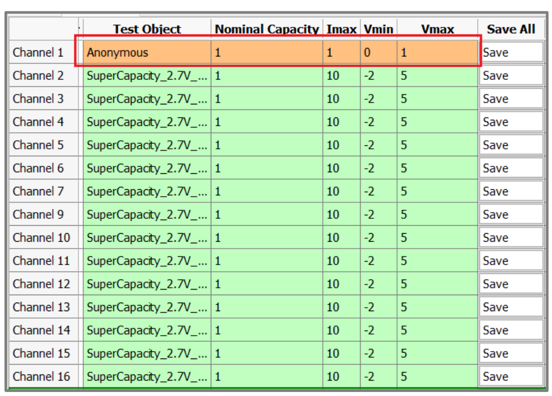
Figure 10-29 Test Object Right-Click menu in Channel View

4) Edit a Single Test Object File
   a) Edit the parameter of a loaded, named Test Object File directly in the Monitor Interface.
      i) The Test Object can be defined as Named or Anonymous.
      ii) If a Named Test Object is assigned to multiple channels, a change to this Named Test Object will be reflected on all of its assigned channels.
      iii) If an Anonymous Test Object is assigned to multiple channels, a change to the Anonymous Test Object will only be reflected on this channel.
   b) Click the "Save" button to save the changes.
   c) After converting the Test Object File to an Anonymous Test Object, you can edit parameters and save the changes in the same manner.



	Test Object	Nominal Capacity	Imax	Vmin	Vmax	Save All
Channel 1	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 2	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 3	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 4	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 5	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 6	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 7	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save
Channel 8	SuperCapacity_2.7V_25F.to	5	1	0.2	4	Save

Figure 10-30 Editing the Parameter of a Named Test Object in Detail View



	Test Object	Nominal Capacity	Imax	Vmin	Vmax	Save All
Channel 1	Anonymous	1	1	0	1	Save
Channel 2	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 3	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 4	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 5	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 6	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 7	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 9	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 10	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 11	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 12	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 13	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 14	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 15	SuperCapacity_2.7V_...	1	10	-2	5	Save
Channel 16	SuperCapacity_2.7V_...	1	10	-2	5	Save

Figure 10-31 Editing the Parameter of an Anonymous Test Object in Detail View

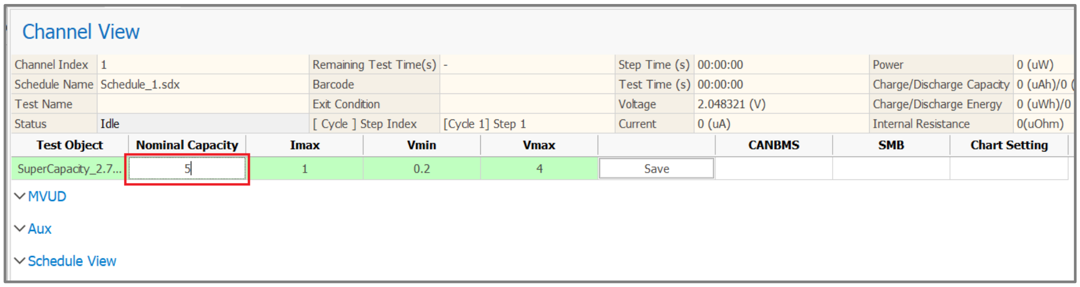


Figure 10-32 Editing the Parameter of a Named Test Object in Channel View

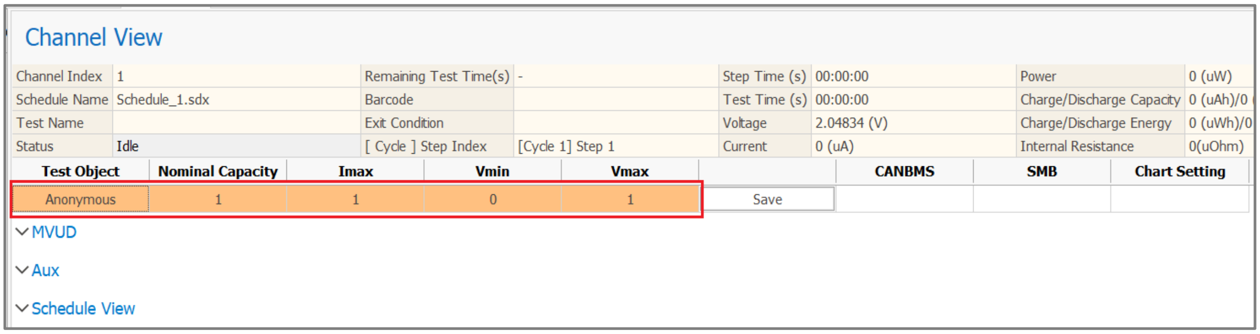


Figure 10-33 Editing the Parameter of an Anonymous Test Object in Channel View

5) Batch Modify Test Object File Parameters and Anonymous Test Object Parameters
   a) Right-click on the column header to open the pop-up menu.
   b) Fill in the value for the selected parameter.
   c) Click the "OK" button.

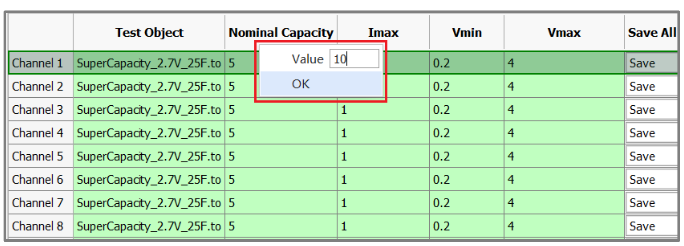


Figure 10-34 Editing Anonymous Test Object in Detail View

6) Use the Interface Display Status
   a) At initiation, the channels are anonymous, each parameter value is displayed as empty, and NULL icons are displayed at the front of the table.
   b) NULL icons disappear after parameters values have been entered.

Test Object	Nominal Capacity	Imax	Vmin	Vmax	Auto Calculate	Mass	Specific Capacity	Nominal IR	Nominal Voltage	Nominal Capacitance	Save All
Anonymous	NULL	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save
Anonymous	NULL	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save

Figure 10-35 NULL When Parameter Values are Empty

Test Object	Nominal Capacity	Imax	Vmin	Vmax	Auto Calculate	Mass	Specific Capacity	Nominal IR	Nominal Voltage	Nominal Capacitance	Save All
Anonymous	1	1	1	11	☐	1	1	1	1	1	Save
Anonymous	1	1	1	11	☐	1	1	1	1	1	Save

Figure 10-36 The Numbers Shows up after Entering

c) The table content may be set to a NULL value and verified by the input content only in the Anonymous state. References to Test Object files must always have values.

Test Object	Nominal Capacity	Imax	Vmin	Vmax	Auto Calculate	Mass	Specific Capacity	Nominal IR	Nominal Voltage	Nominal Capacitance	Save All
Anonymous	NULL	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save
Anonymous	NULL	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save
SuperCapacity_2.7V_25F.to	5	5	0	5	☐	0	0	0	0	0	Save
SuperCapacity_2.7V_25F.to	5	5	0	5	☐	0	0	0	0	0	Save

Figure 10-37 Showing Anonymous and Test Objects States

d) In the Anonymous state:
   i) Check Auto Calculate and if one of Mass and Specific Capacity is empty, Nominal Capacity will be displayed as empty.
   ii) If the save option is Always Overwrite Original or Always Save Anonymous, and the saved content is directly written to the corresponding .ts file.
   iii) If the save option is Always Save As New Test Object and if one of the parameter values is empty, the new Test Object file cannot be saved.

e) When performing the right-click Clear Test Object operation, the channel is switched to Anonymous mode, each parameter value is modified to be empty, and the corresponding .ts file parameter item is also modified to be empty.

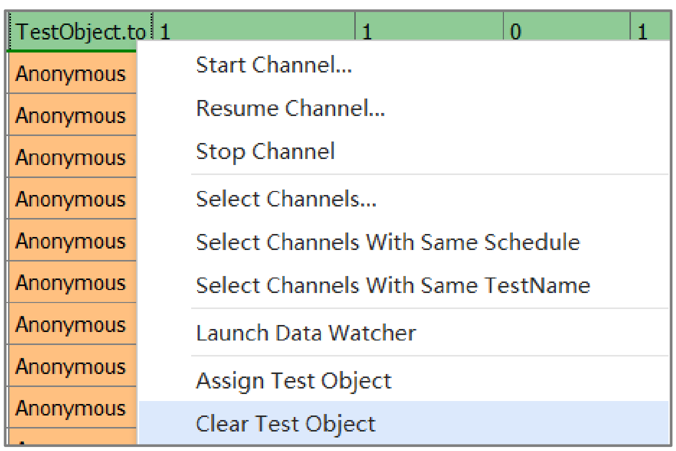


Figure 10-38 Right-Click Menu Pointing on Clear Test Object

f) After a parameter is modified, it will display in a red font, and will turn black after being saved.

Test Object	Nominal Capacity	Imax	Vmin	Vmax	Auto Calculate	Mass	Specific Capacity	Nominal IR	Nominal Voltage	Nominal Capacitance	Save All
Anonymous	1	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save
Anonymous	1	NULL	NULL	NULL	☐	NULL	NULL	NULL	NULL	NULL	Save
SuperCapacity_2.7V_25F.to	6	56	0	58	☐	0	8	0.8	0.8	0.8	Save
SuperCapacity_2.7V_25F.to	6	56	0	58	☐	0	8	0.8	0.8	0.8	Save

Figure 10-39 Red Text Indicates Values That Have Been Modified But Not Saved

7) Check Operation when Starting/Resuming a Channel

a) When there is a C-Rate step in the Schedule File and the current channel is in an Anonymous state, you need to check the Nominal Capacity value. If the Nominal Capacity value is empty, a warning Interface will appear and the test will not run.
b) When the Schedule File configures in the percentage form in Safety, Log And Others, and the current channel is Anonymous, you need to check the values of Imax, Vmin, Vmax, and Nominal Capacity. If one of the values for Imax, Vmin, Vmax, or Nominal Capacity is empty, a warning Interface will appear and the test will not run.

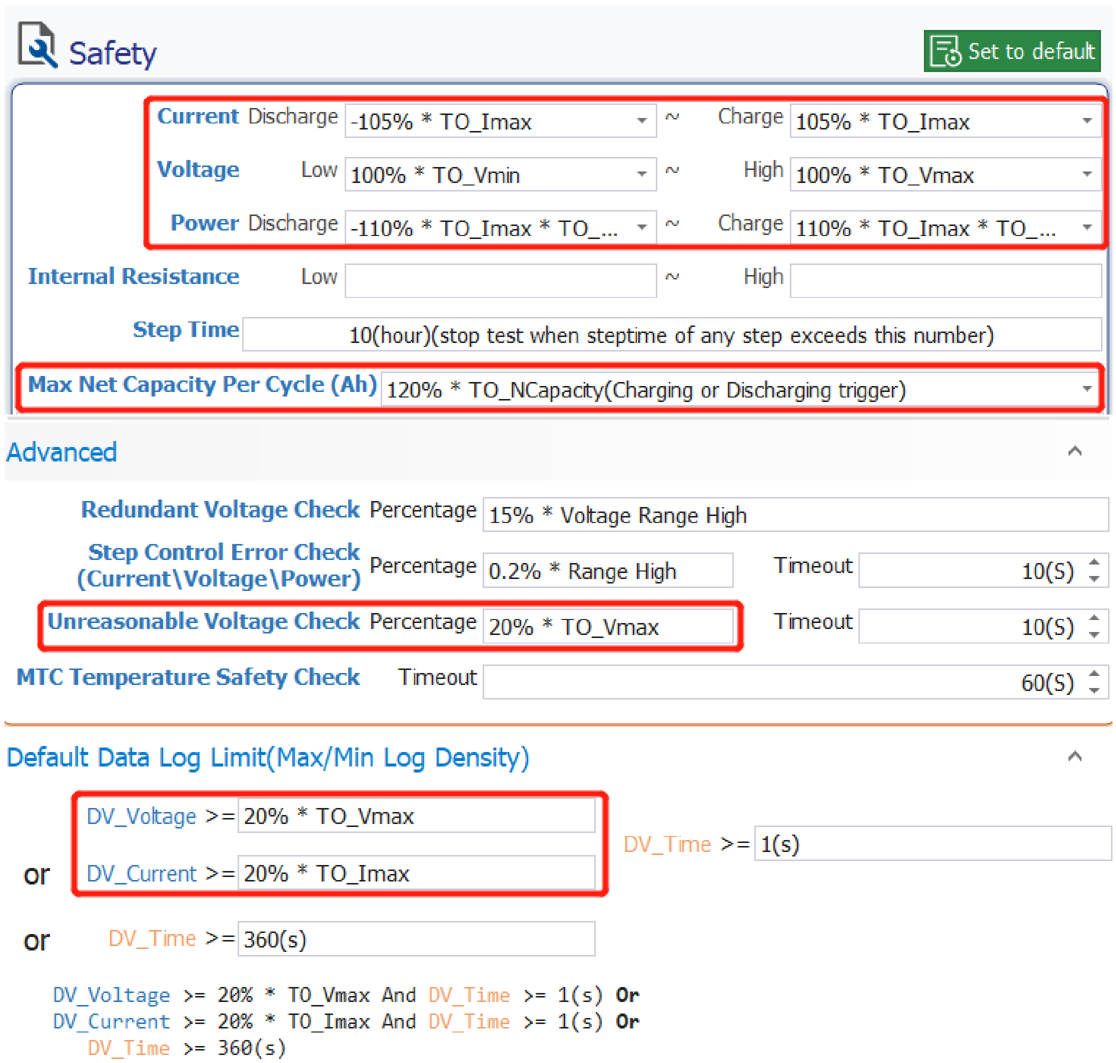


Figure 10-40 The Check from Global Page

c) When a Meta Variable is used in Schedule file Step or Formula, Advance Formula and the value used is Mass, SpecificCapacity, NominalCapacity, NominalVoltage and the current channel is anonymous, you need to check the Mass, SpecificCapacity, NominalCapacity, NominalVoltage values. If one of the values is empty, a warning Interface will appear and the test will not run.
d) When a CANBMS file is used on the current channel, and Formula uses a Meta Variable which value is Mass or SpecificCapacity or NominalCapacity or

NominalVoltage, and the current channel is anonymous, you need to check the Mass, SpecificCapacity, NominalCapacity, NominalVoltage values. If one of the values is empty, a warning Interface will appear and the test will not run.

e) When the Schedule File does not meet the above situations and the current channel is Anonymous and the existing parameters are empty, a warning will still appear in the Start/Resume Channel. You can cancel the warning and run the test.

f) A warning prompt has been added to the Monitor Option configuration interface.

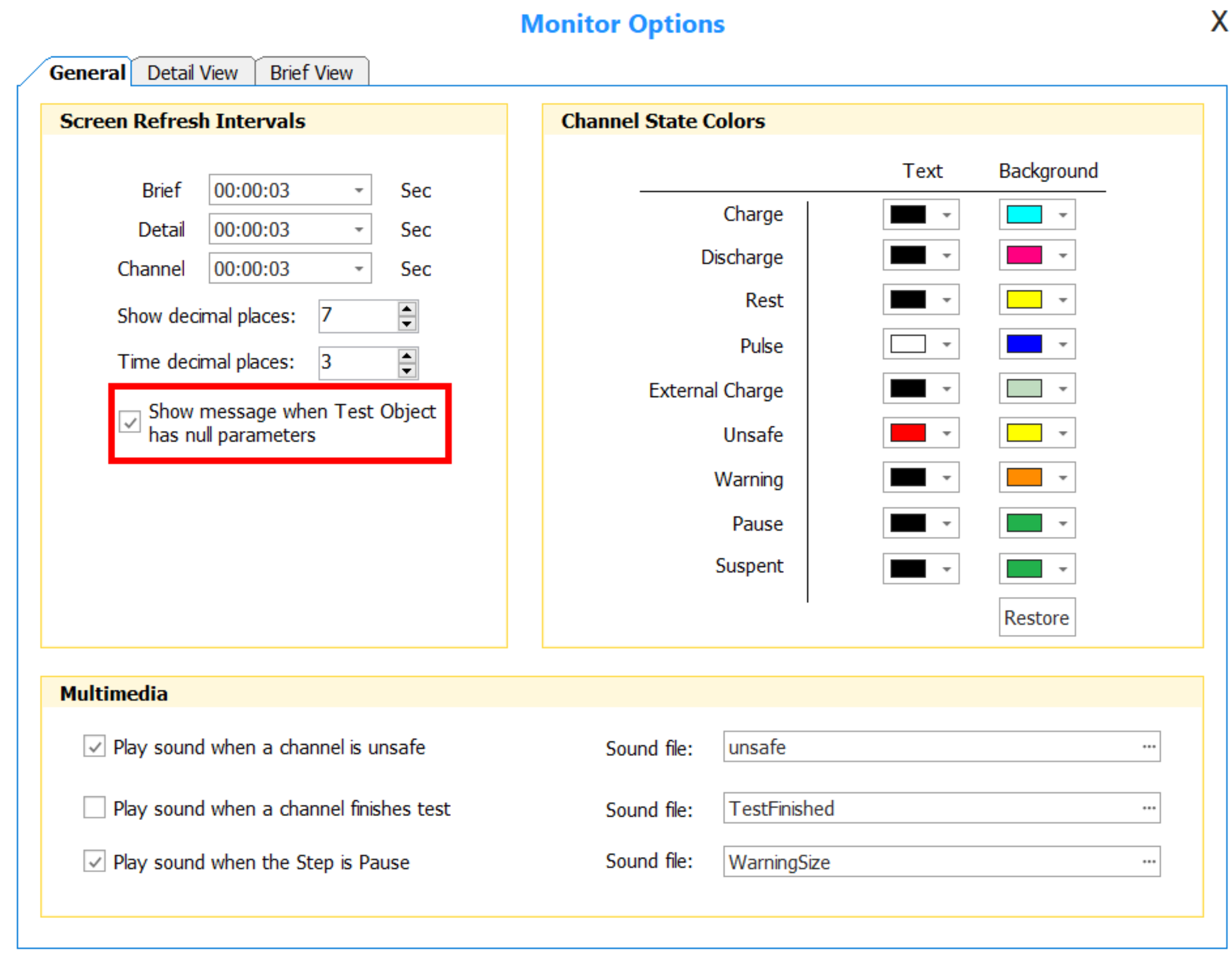


Figure 10-41 The Check from Monitor Options

g) If the Imax field is empty in the Test Object, the Max Current parameter of the Test Object delivered to the firmware is the maximum of the absolute value of Discharge and Charge on the Global Safety Current. If the Vmax field is empty, the Test Object Max Voltage parameter sent to the firmware is the High value of the Global Safety Voltage. The other parameter values of Test Object are empty, and the parameter value sent to the firmware is 0 by default.

10.2.8 Open DataWatcher

1) Open the Monitor Interface.
2) Left-click the name of a single channel or left-click and drag to select multiple channels.
3) Click the “DataWatcher” icon in the Monitor Toolbar to open DataWatcher.

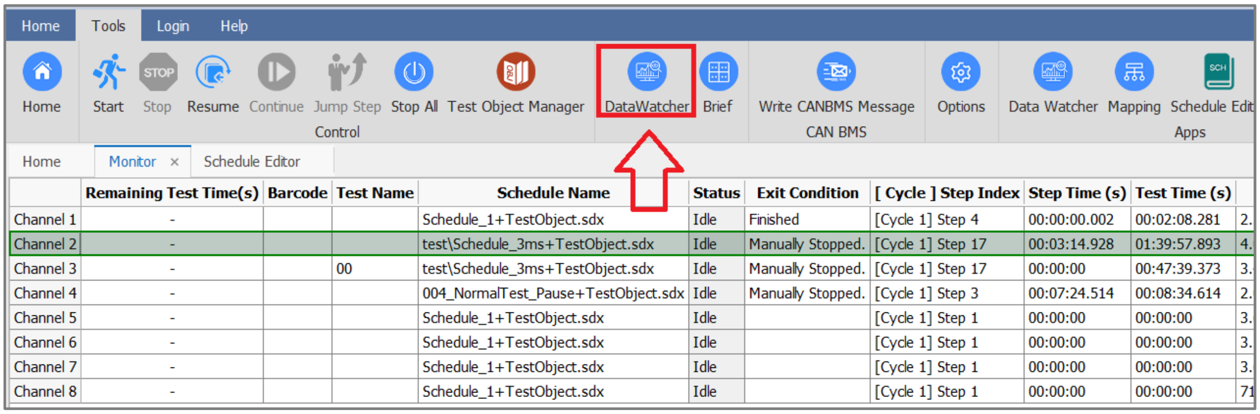


Figure 10-42 Open DataWatcher

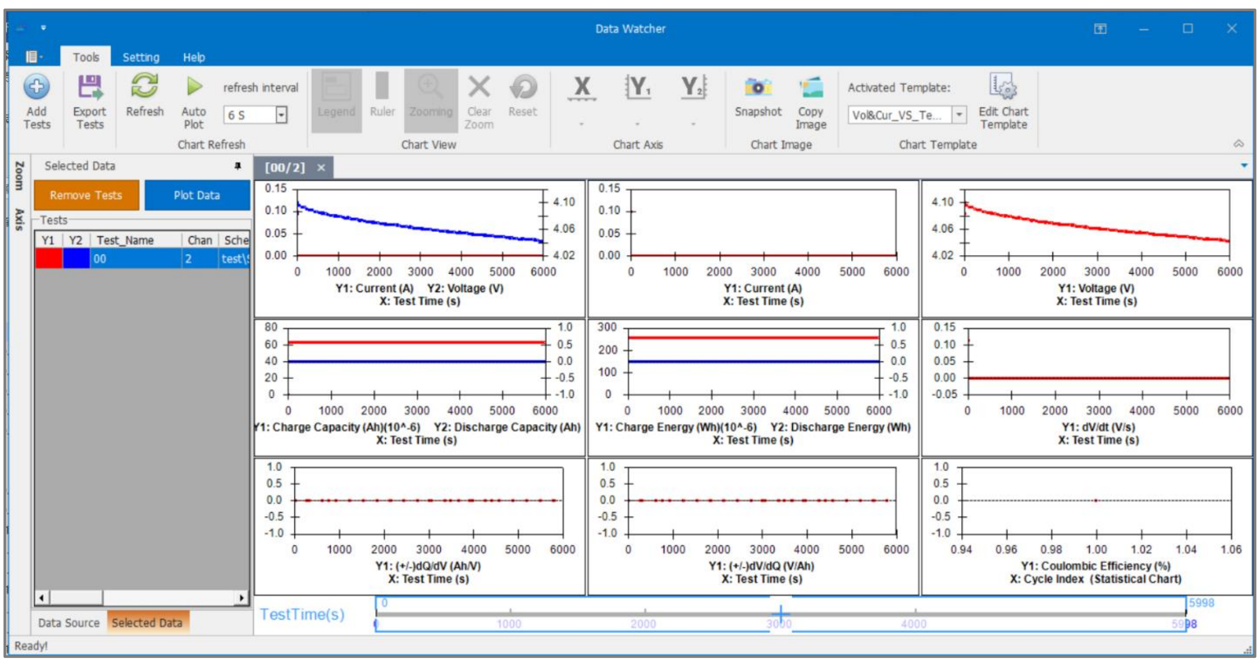


Figure 10-43 The DataWatcher Interface

For more information on specific uses of DataWatcher, refer to **Chapter 11: DataWatcher**.

10.2.9 Switch Between Brief and Detailed View

1) When in Detail View, click on the “Brief” icon in the Monitor Toolbar to switch from Detail View to Brief View.
2) When in Brief View, click on the “Detail” icon in the Monitor Toolbar to switch from Brief View to Detail View.

10.2.10 Write a CAN BMS Broadcast Message

Assign CAN BMS to a Channel

To write a CAN BMS broadcast message, you need to assign CAN BMS to the channel.

1) Make sure that the CAN BMS Channel Count is set in Config.

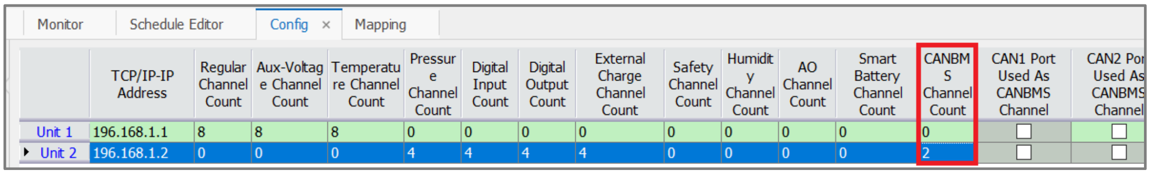


Figure 10-44 Set the CAN BMS Channel Count in Config

2) Add CAN BMS to the channels in Mapping.

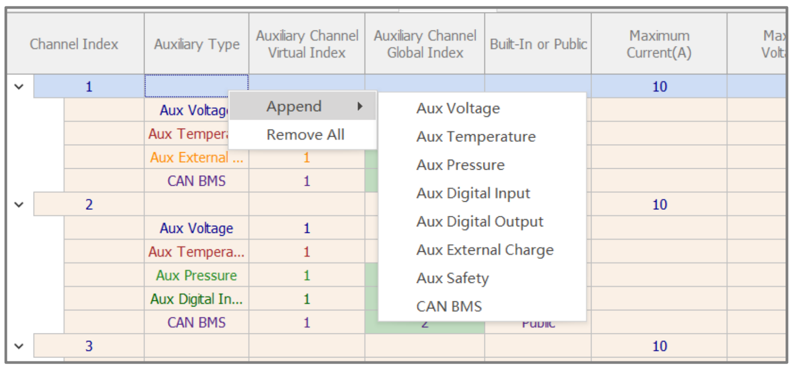


Figure 10-45 Add CAN BMS to Mapping

Open the CAN BMS Message Interface

1) Left-click on the channel to select the channel.
2) Click on the "Write CAN BMS" icon in the Monitor Toolbar to open the "Write CAN BMS Message" Interface.

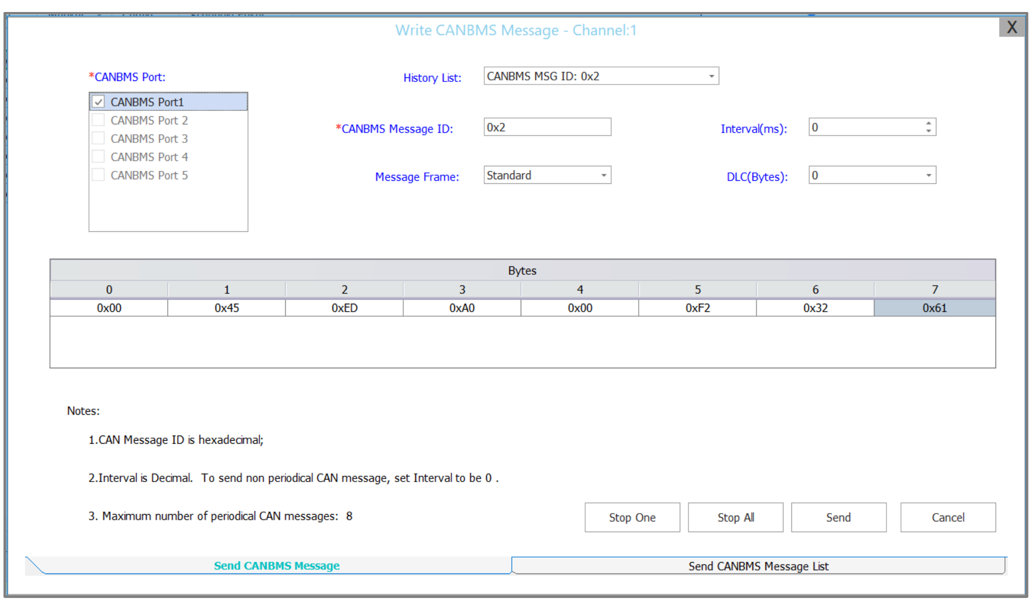


Figure 10-46 Write CAN BMS Message Interface

3) If no CAN BMS is assigned to the channel, click on the "Write CAN BMS Message" Interface and an alert message will appear.

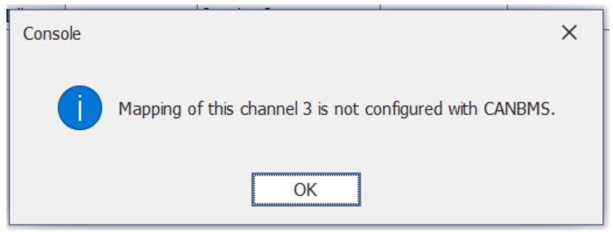


Figure 10-47 Alert Indicating that CAN BMS is Not Configured

Write the CAN BMS Message

There are two options to write a CAN BMS Message, with independent pages:

1) **Send CAN BMS Message** – Send a single CAN message multiple times.
   a) **CAN BMS Port** – Select the CAN port to send the broadcast.
   b) **History List** – Click the small triangle icon on the right size of the History input box to view and select the history.

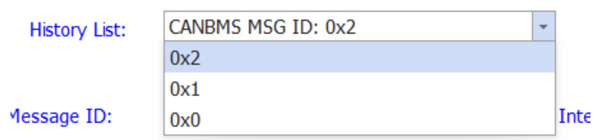


Figure 10-48 History List

   c) **CAN BMS Message ID** – Click the input box to enter the ID of the CAN BMS message.
   d) **Message Frame** – Click this content to set the CAN BMS message frame type.
   e) **Standard Type** – CAN BMS Message ID range of this type is 0x0-0x7FF.
   f) **Extended Type** – CAN BMS Message ID range of this type is 0x0-0x1FFFFFFF.

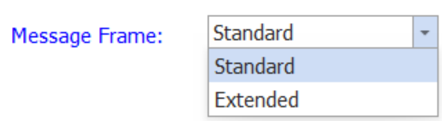


Figure 10-49 Message Frame

      i) If the CAN BMS Message ID is out of range, an alert will pop up, as shown in Figures 10-50 and 10-51.

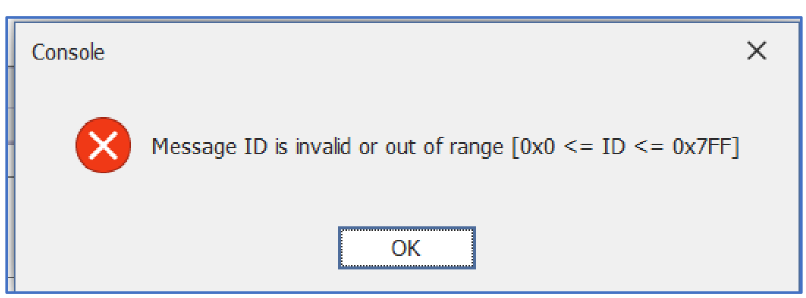


Figure 10-50 Alert Indicating that the Standard Type is Out of Range

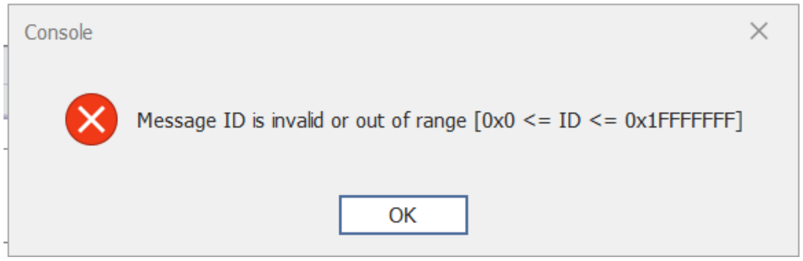


Figure 10-51 Alert Indicating that the Extended Type is Out of Range

g) **Interval** – Set the time interval for sending the CAN BMS message as a decimal number in milliseconds.
   i) If the time interval is 0, the CAN message will be sent only once. Otherwise, it will repeat the CAN message at the specified time interval.
   ii) The minimum time interval is 1 millisecond.

h) **DLC** – Set the number of bytes you want to send. Click the input box to select a value from the drop-down list; minimum is 0 and maximum is 8.

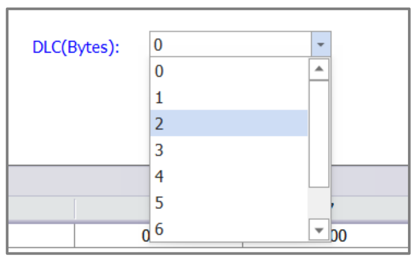


Figure 10-52 Set the Number of Bytes

i) **Bytes** – Set the content of the message to be sent.

j) **Stop One** – Stop the sending of the currently selected CAN ID message.

k) **Stop All** – Stop all messages sending from this interface.

l) **Send** – Click to start sending CAN BMS messages. At present up to 8 messages can be sent repeatedly.

2) **Send CAN BMS Message List** – Send a message list containing up to 256 CAN messages.
   a) Click the tab at the bottom of the Interface to switch to Send CAN BMS Message List.

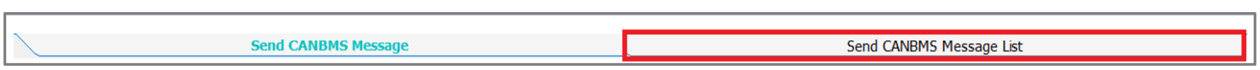


Figure 10-53 Switch to Send CAN BMS Message List

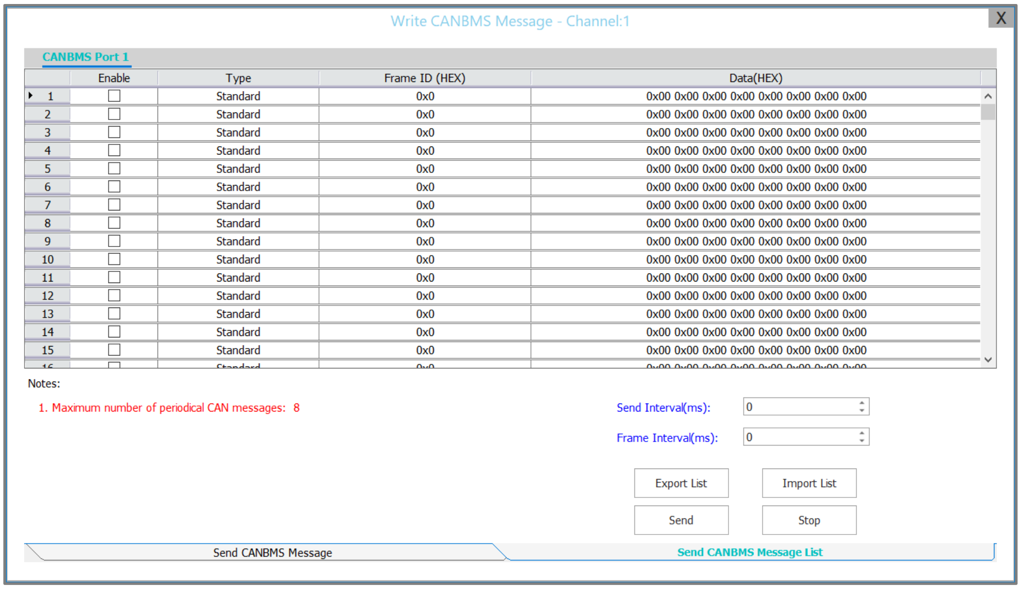


Figure 10-54 The Send CAN BMS Message List Page

b) **Frame ID(HEX)** – CAN ID in hexadecimal.

c) If there are multiple BMS ports, the port number will be displayed at the top of the Interface. Click on the number to switch ports.

d) You can edit the content of the CAN BMS message you want to send, including whether it is Enabled, along with Type, Frame ID, and Data. The message will not be sent until Enable is checked.

e) **Send Interval** – Set the interval between sending messages as a decimal number in milliseconds.

   i) If the time interval is 0, the CAN message of the whole column is sent only once. Otherwise, the time interval will control how soon the CAN message is resent after the CAN message of the whole column is sent.

   ii) The minimum time interval is 1 millisecond.

f) **Frame Interval** – The interval between sending message frames as a decimal number in milliseconds.

   i) The minimum time interval is 1 millisecond.

   ii) At present, up to 256 CAN messages can be sent repeatedly.

g) **Export List** – Export the list.

   i) Click the “Export List” button, select the location you want to save the list to in the Interface that opens, and click “Save” on the Interface to complete the list export.

h) **Import List** – Import a new list.

   i) Click the “Import List” button, select the location of the list you want to import in the Interface that opens, and click “Open” to compete the list import.

i) **Send** – Click to start sending the CAN BMS Message List. The CAN MBS port needs to be checked before sending the CAN BMS Message List.

j) **Stop** – Click to stop sending the CAN BMS Message List.

10.2.10 Manage View Settings

The setting options are used to configure the display styles of the different views.

1) Click on the “Options” icon in the Monitor Toolbar to open the Monitor Options Interface, which includes General, Detail View, and Brief View.

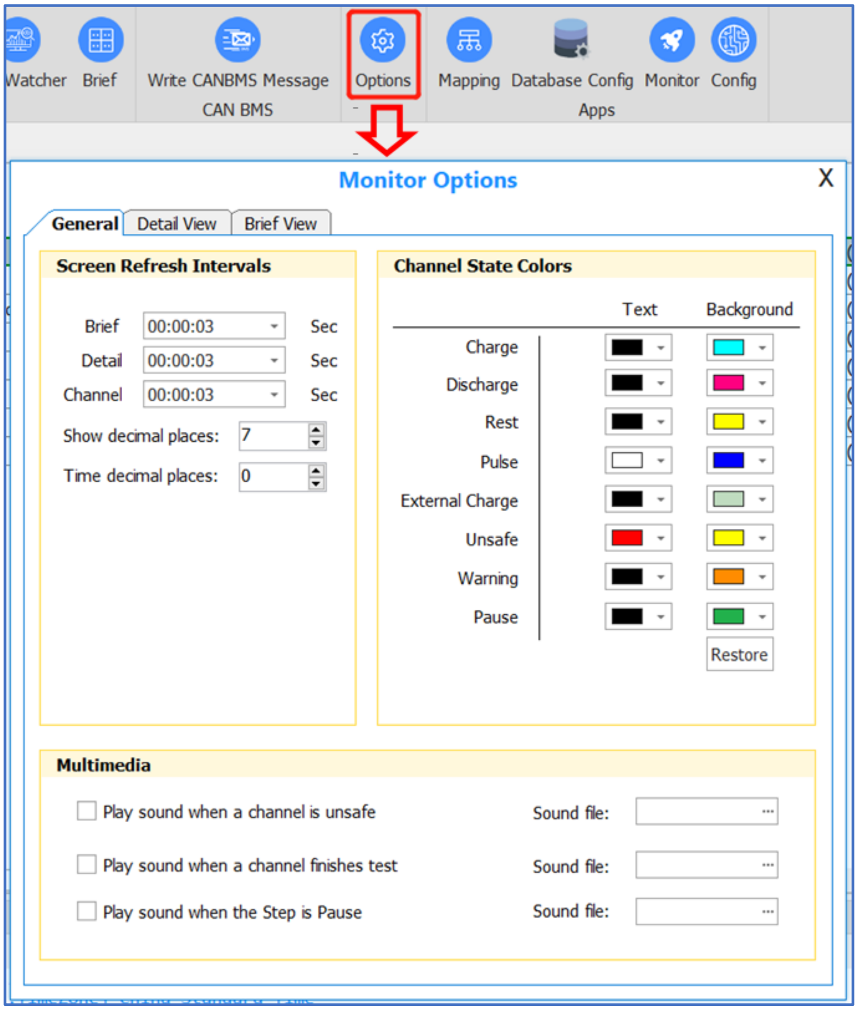


Figure 10-55 Options Interface

Configure the General Settings

1) **Screen Refresh Intervals** – Set the data refresh interval of the Brief View, Detail View and Channel View, in seconds. The default refresh interval is 3 seconds.
2) **Show Decimal Places** – Set the number of decimal places for the displayed data.
3) **Time Decimal Places** – Set the number of decimal places for displaying time.
4) **Channel State Colors** – Indicate the test status by setting various display colors The system provides a default color scheme, but you can specify the color for each test status in the Channel State Colors section of General Settings.
5) **Multimedia** – Indicate the test status by setting different audio tones. Click the icon to set the audio file and check the options to enable the multimedia settings.

Configure the Detail View Settings

1) **Show Items** – Determines whether the parameter column is displayed in Detail View.
2) **Data Grid Area Color** – Set the display style of the Detail View gird.
   a) By default, the color of the data grid area is white.
   b) You can check the “Use UI Style” checkmark box to display according to the system style, check the “Use Default Interfaces Colors” to use the default colors, or customize the colors.
3) **Auto Save Header Row Layout When Closing Interface** – Set whether to automatically save the layout of the title row when the Interface is closed.
   a) If this option is not checked, the layout of the title row will be adaptively set according to the displayed content.
4) **Show Step Label in Step Column** – Set whether to display the Step Label in the Step column.
5) **Show Nickname as Prefix of Each Auxiliary Datum** – Set whether to display the nickname as the prefix of each auxiliary data point.

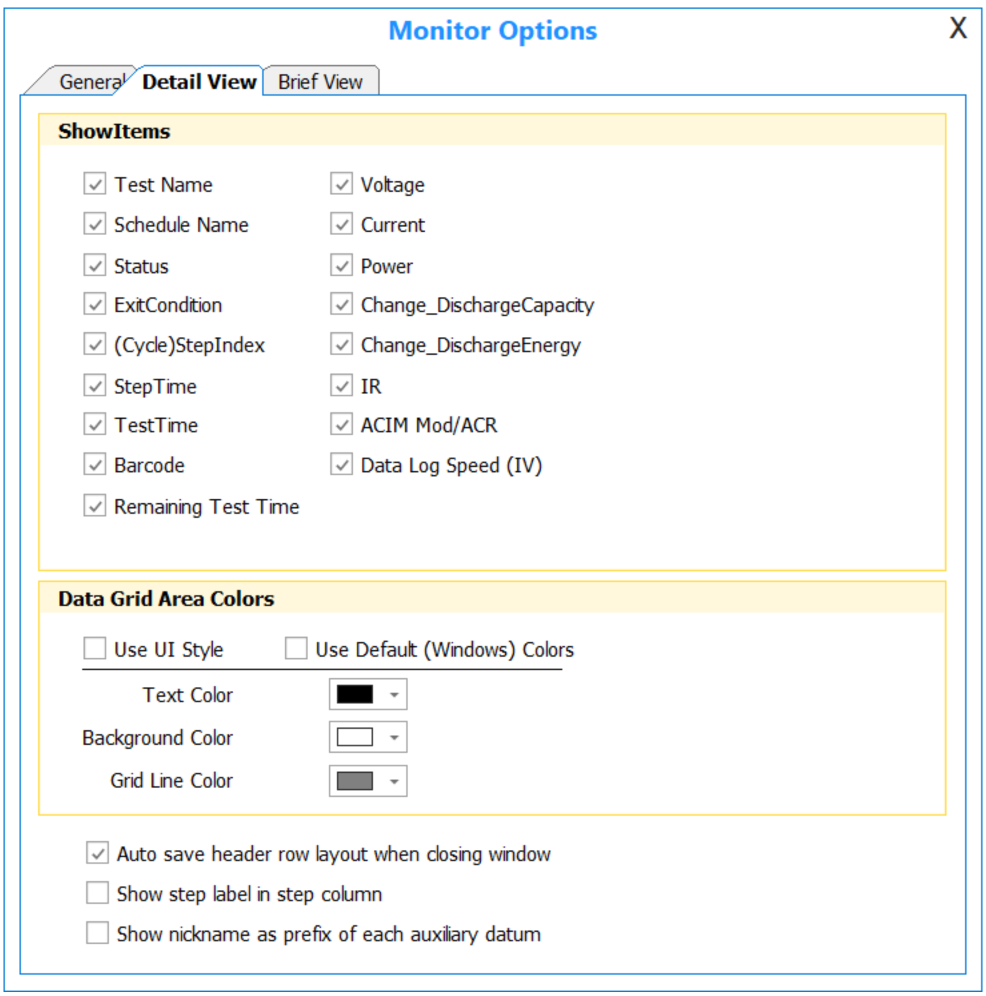


Figure 10-56 Detail View Settings Interface

Configure the Brief View Settings

General Display Options: By default, the Brief View displays the StepIndex, Current, and Voltage. You can choose whether to display CycleIndex and Barcode. For Smart Battery Testing, you can choose to display more CAN BMS variable information in each unit.

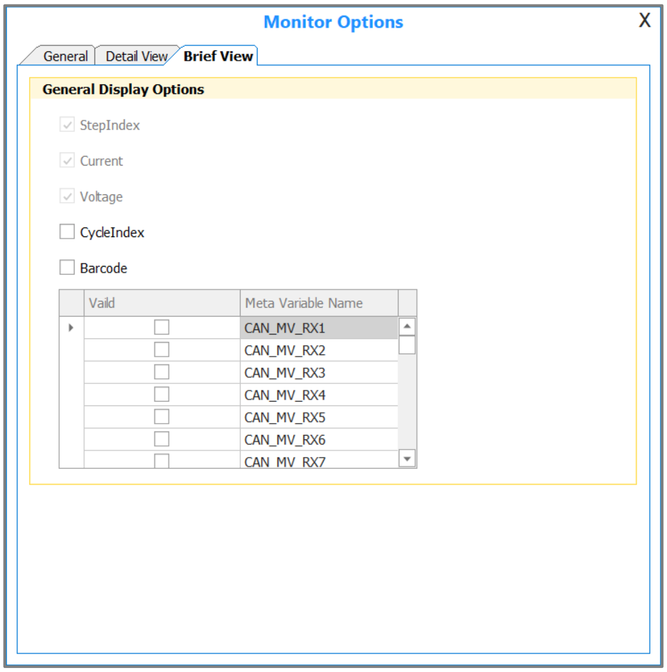


Figure 10-57 Brief View Settings Interface

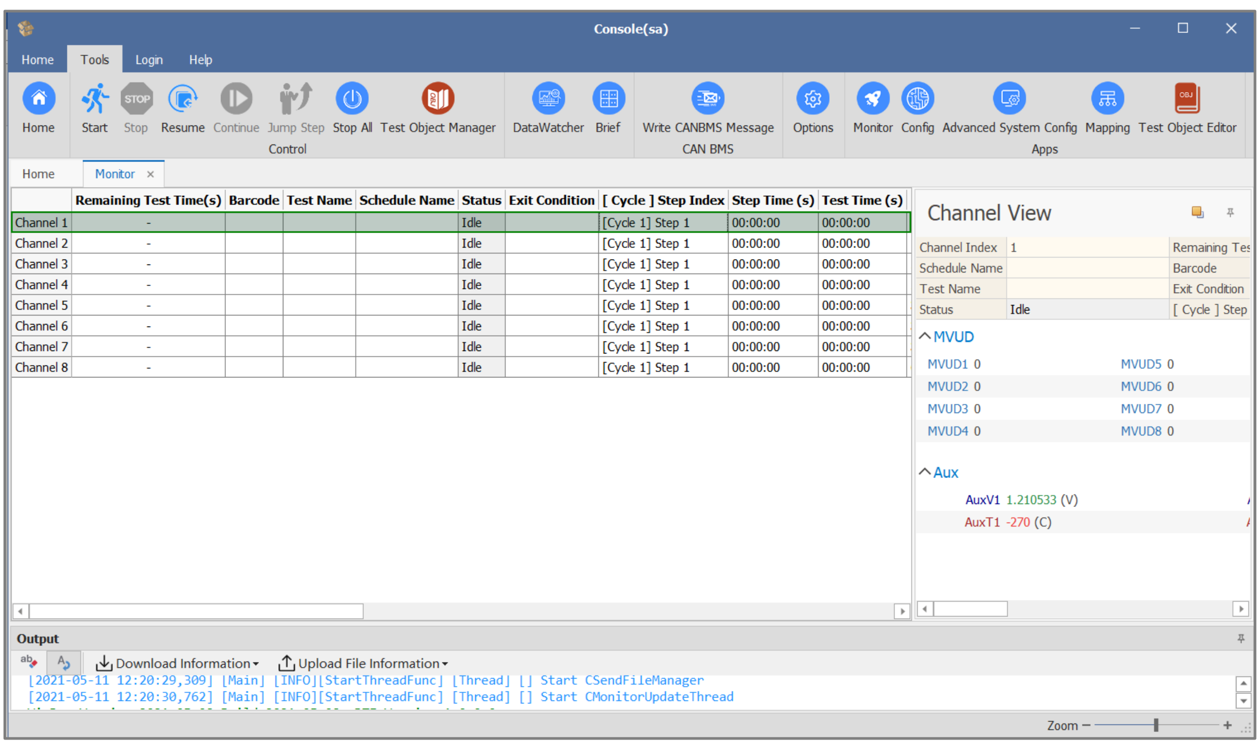


Figure 10-58 Monitor Interface

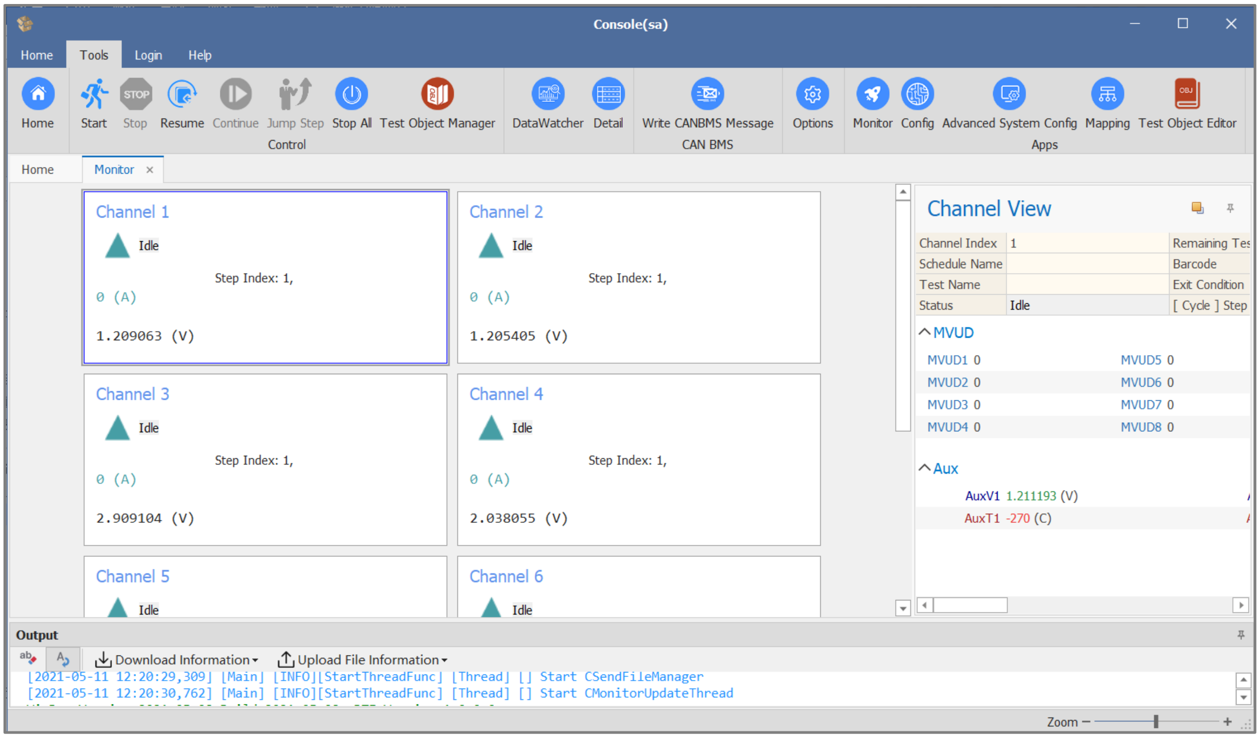


Figure 10-59 Switch Detail View to Brief View Display

10.3 Manage Tests in the Detail View

10.3.1 Introduction to the Detail View

The Detail View provides you with detailed information about the test channel.

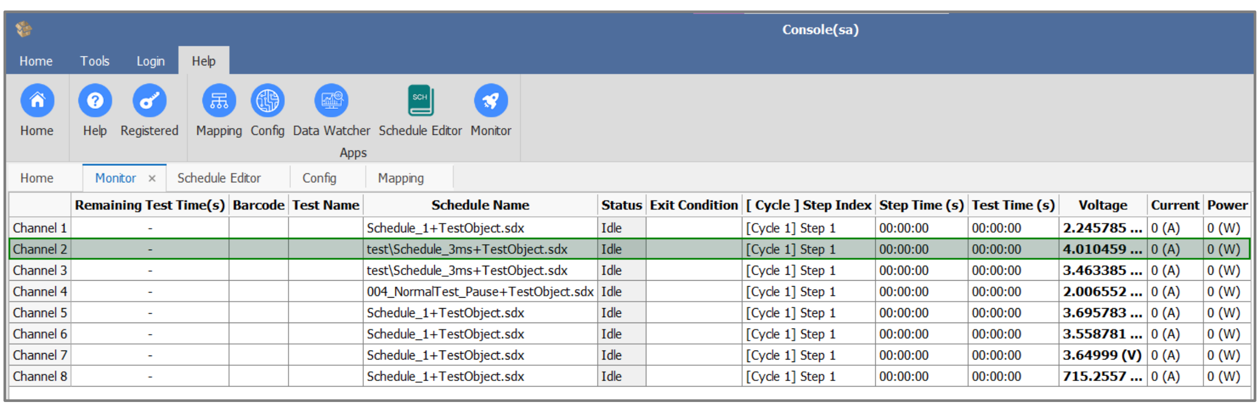


Figure 10-60 The Detail View

Detail View Field Descriptions

Field	Description
Remaining Test (Times)	The remaining time on the global page of the test process. (The remaining time of the test is displayed before completion.)
Barcode	The barcode of the battery; you can add the barcode here.
Test Name	The file name for recording the data.
Schedule Name	The Schedule File name of the running test.
Status	The status of the channel (see Color Status.)
Exit Condition	The reason the test was stopped or exited.
[Cycle] Step Index	The number of the step currently being executed in [Number of Cycles].
Step Time	Calculate the elapsed time from the beginning of the current active step.
Test Time	Calculate the elapsed time from the beginning of the current active test.
Voltage	The voltage value of present channel.
Current	The current value of present channel.
Power	The power value of present channel.
Charge/Discharge Capacity	The cumulative value of the present channel's charge and discharge capacity.
Charge/Discharge Energy	The accumulated value of charge/discharge energy of the present channel.
Internal Resistance	Measured internal resistance (refer to Appendix A-Internal Resistance Control Type).
ACIM Mod/ACR	AC impedance test ACIM module.
ACIM Phase	ACIM phase.
Data Log Speed (IV)	Display the speed of IV data logging to the database.

Detail View Status Descriptions

Status	Indication
Idle	The channel is not being used.
Rest	The charge/discharge circuit is disconnected from the test sample, but the voltage measurement circuit is still connected.
Charge	Measured channel current is positive at present.
Discharge	Measured channel current is negative at present.
Pulse	The channel is generating current or voltage pulses.
Internal Resistance	The channel is performing internal resistance measurement.
Unsafe	Value of any parameters exceeds the safety limit set in schedule [**Global]** page, or in config file.
External Charge	Mits X disables the current and voltage control of the main IV channel and records the current that flows through the External Charge adaptor and voltage of object. Main IV channel can disconnect the charger with the test object by the voltage or the step time.
Finished	The test has proceeded to completion and terminated according to the Schedule and Limits.
Transition	The microcontroller has delayed data acquisition while it is processing operations associated with step changes.
Test Setting	Mits X maintains a waiting condition on a channel while attempting to attain Test Setting Values.
Pause	The charge/discharge circuits are disconnected from the test sample, but the voltage measurement circuit is still connected, no data log and press continue button test will go to next step.

10.3.2 Start Channels Testing

Start Testing on a Single Channel

1) Right-click on the name of the channel you want to start testing.
2) Select the "Start Channel..." option from the menu that appears.
3) Enter the information in the Interface that appears.
4) Click the "OK" button at the bottom of the Interface to start testing the selected channel.

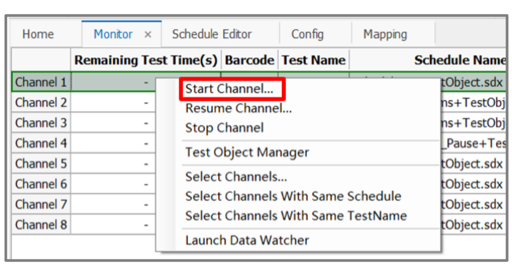


Figure 10-61 Start Testing on a Single Channel

Start Testing on Multiple Channels Simultaneously

1) Left-click and drag to select multiple channels that you want to start testing.
2) Right-click on the selected channels.
3) Select the “Start Channel...” option from the menu that appears.
4) Enter the information in the Interface that appears.
5) Click the “OK” button at the bottom of the Interface to start testing on the selected channels.

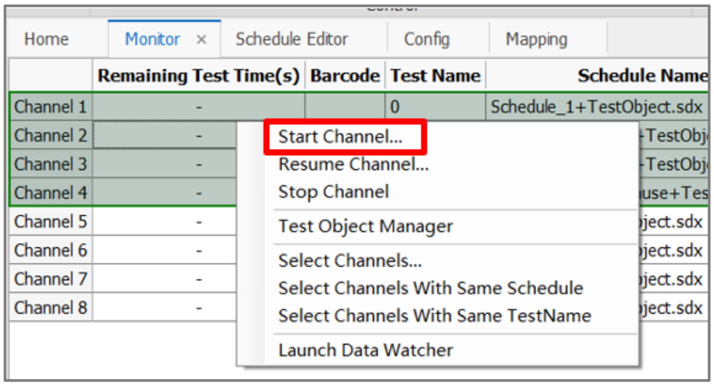


Figure 10-62 Start Testing on Multiple Channels Simultaneously

10.3.3 Stop Channels Testing

Stop a Test on a Single Channel

1) Right-click on the name of the channel you want to stop testing.
2) Select the “Stop Channel...” option from the menu that appears to stop testing on the selected channel.

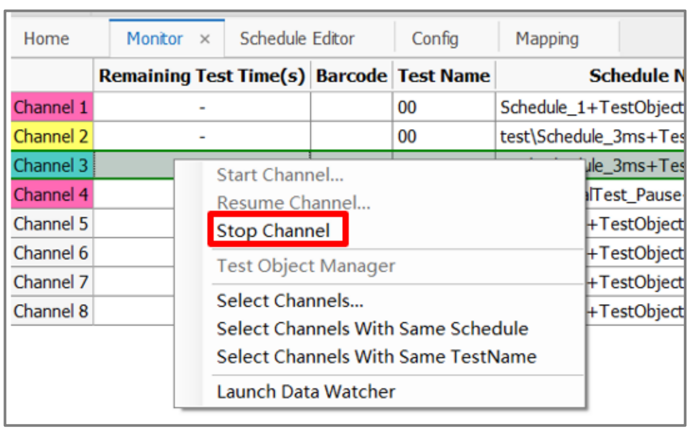


Figure 10-63 Stop Testing on a Single Channel

Stop Testing on Multiple Channels Simultaneously

1) Left-click and drag to select multiple channels that you want to start testing.
2) Right-click on the selected channels.
3) Select the “Stop Channel...” option from the menu that appears to stop testing on the selected channels.

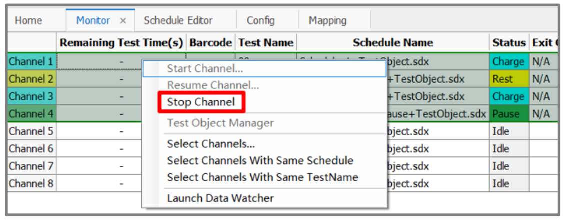


Figure 10-64 Stop Testing on Multiple Channels Simultaneously

10.3.4 Resume Channels Testing

Resume Testing on a Single Channel

1) Right-click on the name of the channel you want to resume testing.
2) Select the “Resume Channel...” option from the menu that appears.
3) Enter the information in the Interface that appears.
4) Click the “OK” button at the Interface bottom to resume testing the selected channel.

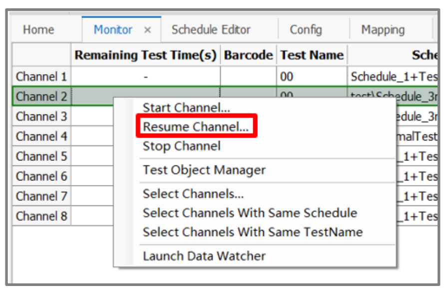


Figure 10-65 Resume Testing on a Single Channel

Resume Testing on Multiple Channels Simultaneously

- Left-click and drag to select multiple channels that you want to resume testing.
- Right-click on the selected channels.
- Select the “Resume Channel...” option from the menu that appears.
- Enter the information in the Interface that appears.
- Click the “OK” button at the bottom of the Interface to resume testing on the selected channels.

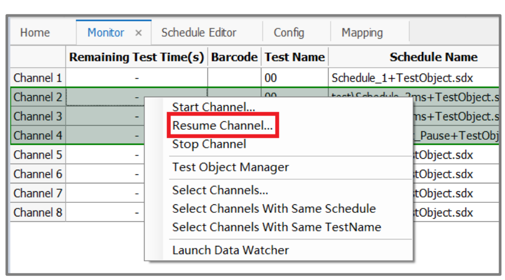


Figure 10-66 Resume Testing on Multiple Channels Simultaneously

10.3.5 Select Channels

Select Channels by Channel Number

1) Right-click on the channel list.
2) Click on the “Select Channel” option in the menu that appears.
3) Enter the channel number range you want to select in the Interface that appears.
4) Click the “OK” button at the bottom of the Interface to select the channels.

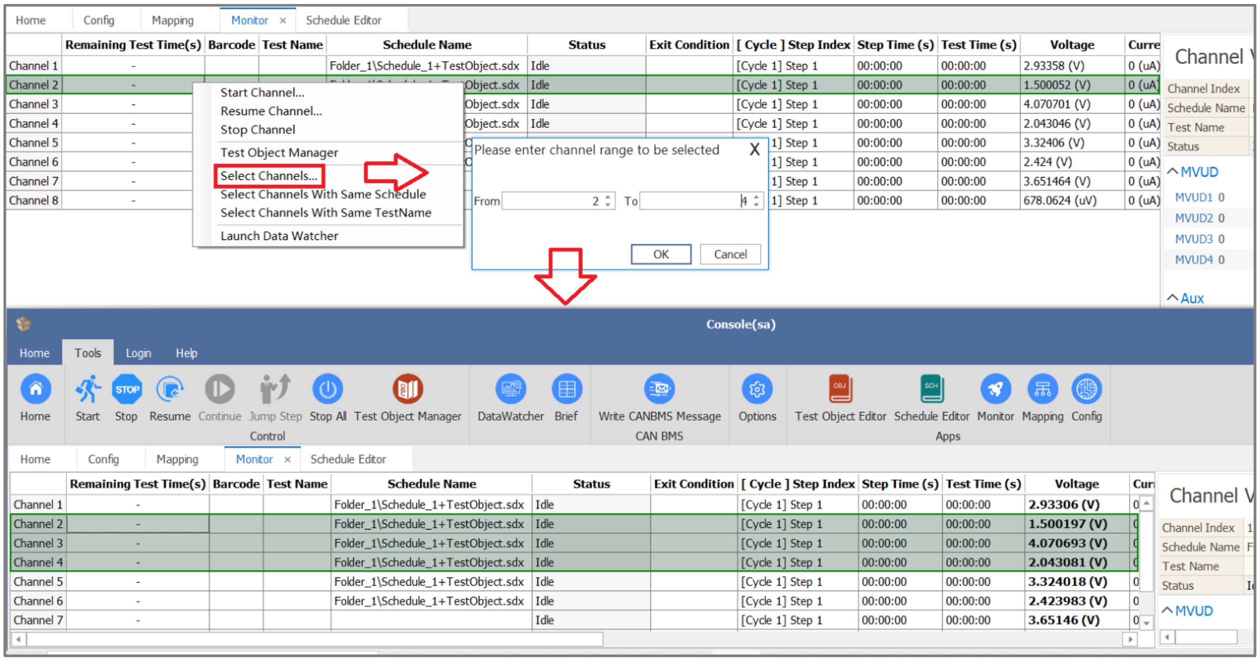


Figure 10-67 Select Channels

Select Channels with the Same Schedule

1) Right-click on a channel in the channel list that has the Schedule you want to select.
2) Click on the “Select Channel With Same Schedule” option in the menu that appears to select all channels with the same Schedule.

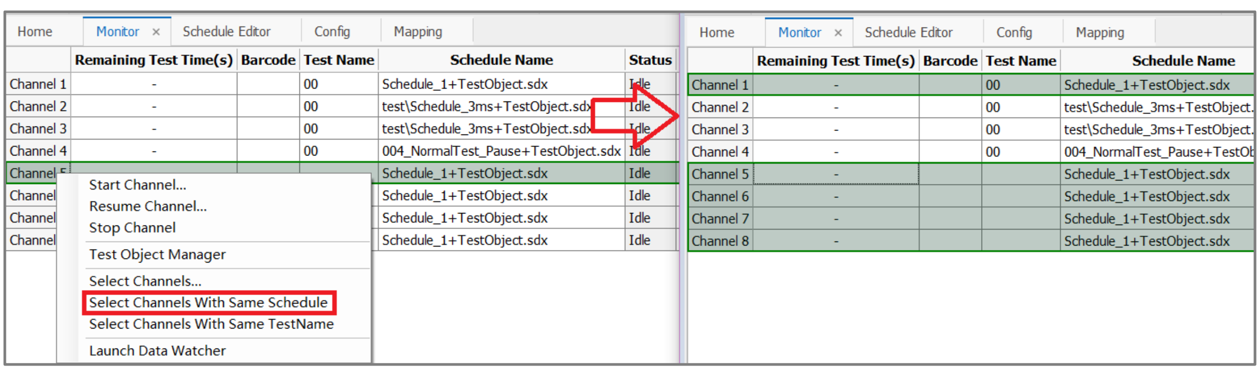


Figure 10-68 Select Channels with the Same Schedule

Select Channels with the Same Test Name

1) Right-click on a channel in the channel list with the Test name you want to select.
2) Click on the "Select Channel With Same TestName" option in the menu that appears to select all channels with the same Schedule.

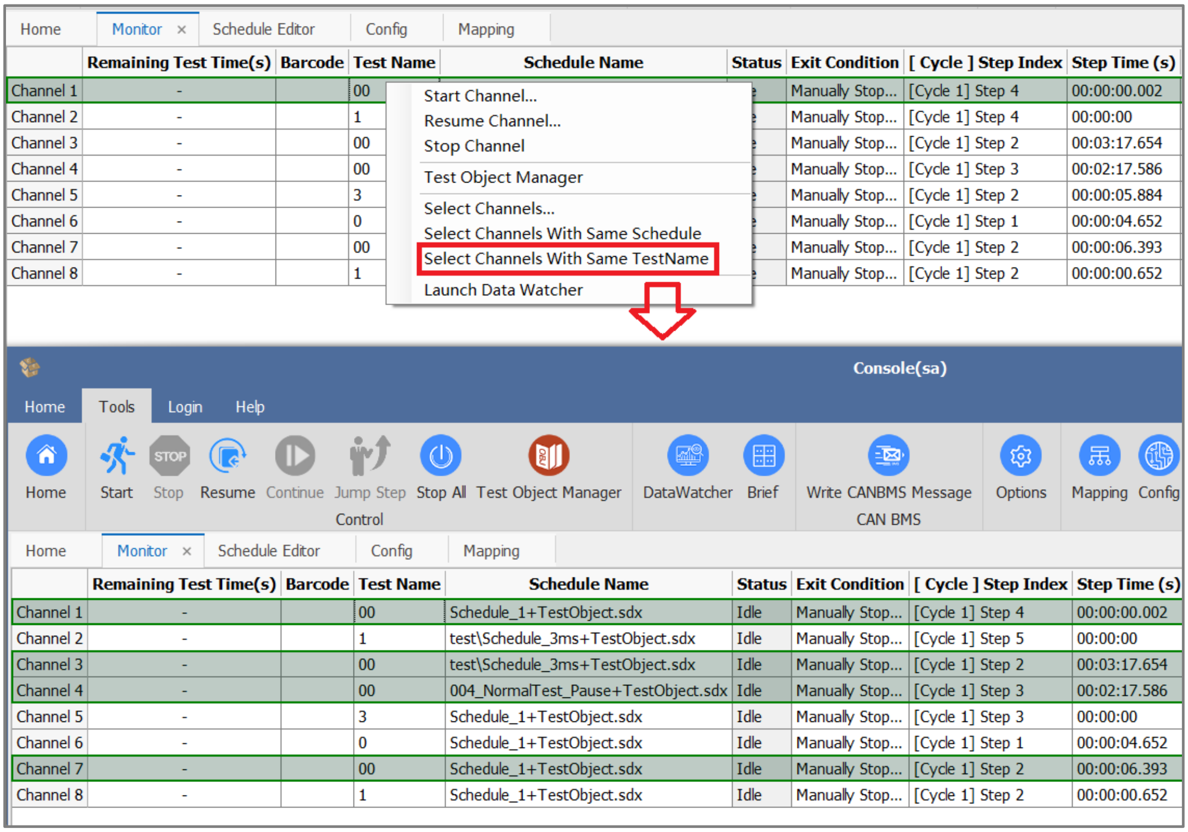


Figure 10-69 Select Channels with the Same Test Name

10.3.6 View Channel Data with DataWatcher

View the Data of a Single Channel

1) Right-click the channel you want to view in DataWatcher.
2) Click on the "Launch DataWatcher" option in the menu that appears to open DataWatcher for the selected channel.

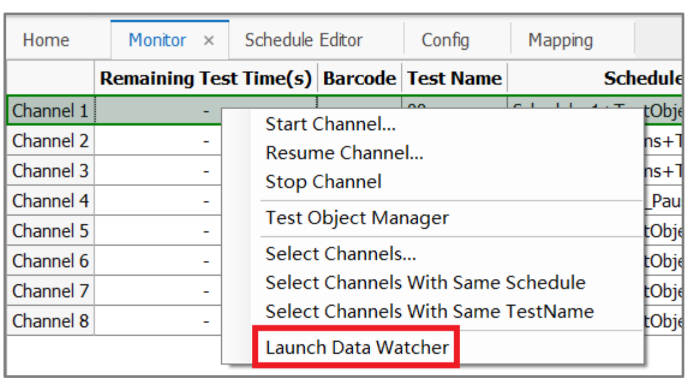


Figure 10-70 View the Data of a Single Channel

View the Data of Multiple Channels Simultaneously

1) Left-click and drag to select the channels you want to view in DataWatcher.
2) Right-click on the selected channels.
3) Click on the "Launch DataWatcher" option in the menu that appears to open DataWatcher for the selected channels.

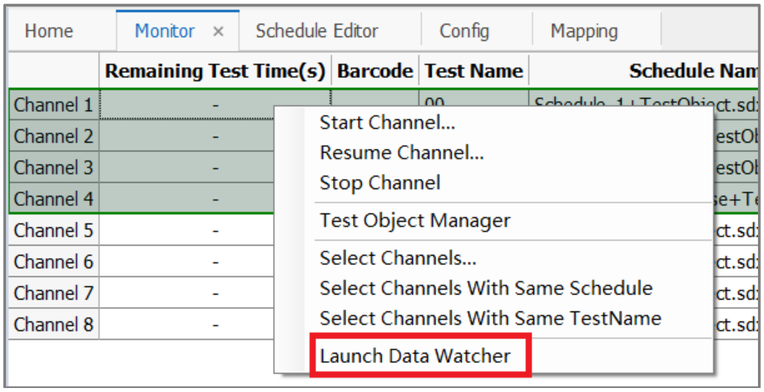


Figure 10-71 View the Data of Multiple Channels

10.3.7 Assign Schedules to Channels

Assign a Schedule to a Single Channel

1) Right-click the channel to which you want to assign a Schedule.
2) Click on the "Assign Schedule" option in the menu that appears.
3) Select the Schedule to be assigned to the channel in the "Assign Schedule" Interface that appears.
4) Click the "OK" button at the bottom of the "Assign Schedule" Interface to assign the selected Schedule to the selected channel.

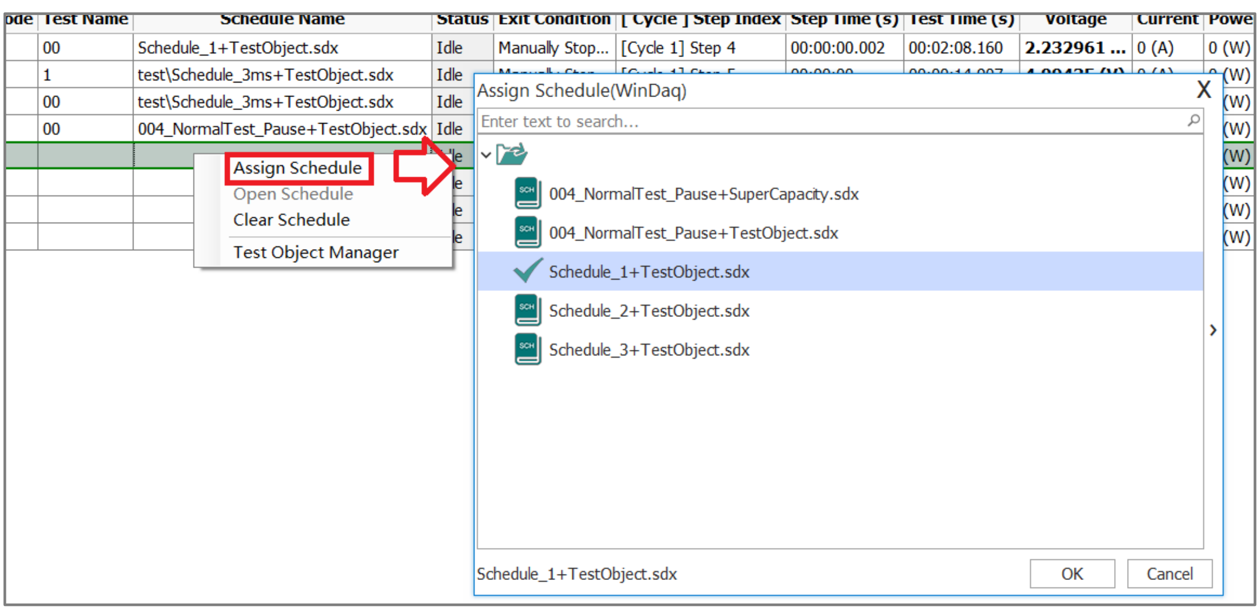


Figure 10-72 Assign a Schedule to a Single Channel

Assign Schedules to Multiple Channels Simultaneously

1) Left-click and drag to select the channels to which you want to assign a Schedule.
2) Right-click on the selected channels.
3) Click on the “Assign Schedule” option in the menu that appears.
4) Select the Schedule to be assigned to the channels in the “Assign Schedule” Interface that appears.
5) Click the “OK” button at the bottom of the “Assign Schedule” Interface to assign the selected Schedule to the selected channels.

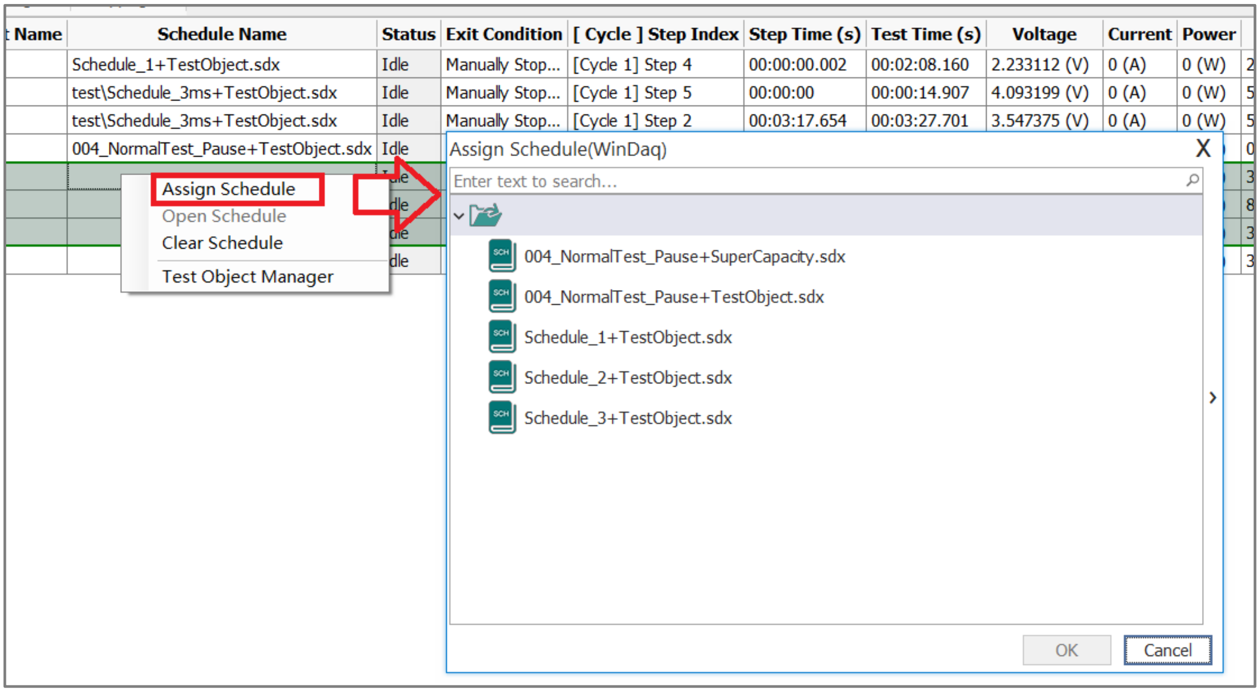


Figure 10-73 Assign a Schedule to Multiple Channels

10.3.8 Open a Schedule

Open a Schedule for a Single Channel

1) Under the Schedule Name field, right-click on the Schedule Name for the channel assigned to the Schedule you want to open.
2) Click the “Open Schedule” option on the menu that appears to open the Schedule for the selected channel.

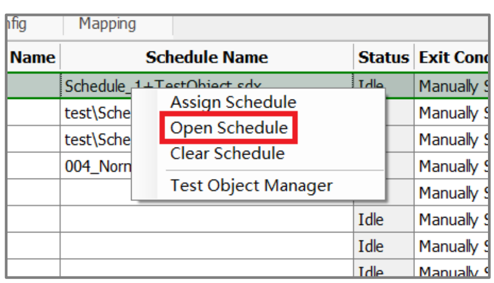


Figure 10-74 Open a Schedule

Open the Schedules for Multiple Channels

1) Under the Schedule Name field, right-click and drag to select the Schedule Names for the channels assigned to the Schedules you want to open.
2) Right-click on the selected Schedule Names.
3) Click on the “Open Schedule” option on the menu that appears to open the Schedules for the selected channels.

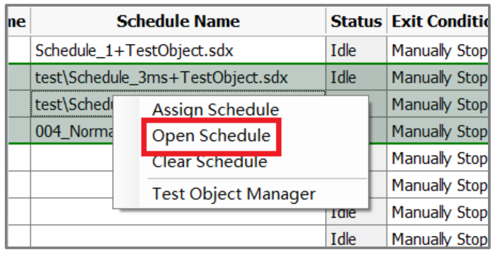


Figure 10-75 Open Multiple Schedules Simultaneously

10.3.9 Clear Schedules

Clear the Schedule for Multiple Channels

1) Under the Schedule Name field, right-click on the Schedule Name for the channel from which you want to clear the Schedule.
2) Click on the “Clear Schedule” option on the menu that appears to clear the Schedule from the selected channel.

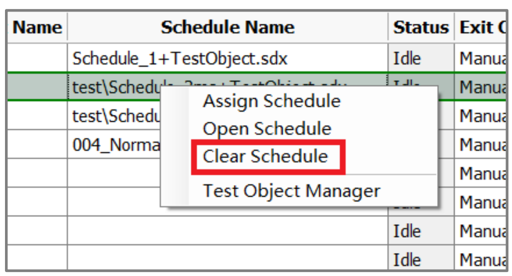


Figure 10-76 Clear a Schedule

Clear Schedules for Multiple Channels

1) Under the Schedule Name field, right-click and drag to select the Schedule Names for the channels from which you want to clear the Schedule.
2) Right-click on the selected Schedule Names.
3) Click on the “Clear Schedule” option on the menu that appears to clear the Schedule from the selected channels.

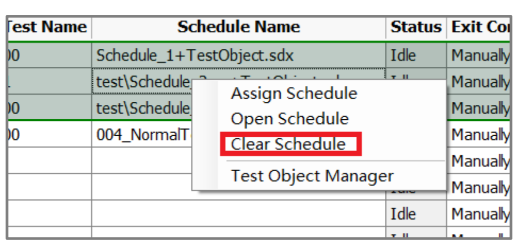


Figure 10-77 Clear Multiple Schedules Simultaneously

10.4 Use Additional Monitor Views

10.4.1 Use the Brief View

The Brief View provides users with brief information about the test channel.

1) Channel Number
2) Channel Status
3) For information about the current channel, refer to Options described in **10.2 Manage Channels with The Monitor Toolbar**.
4) Current
5) Voltage

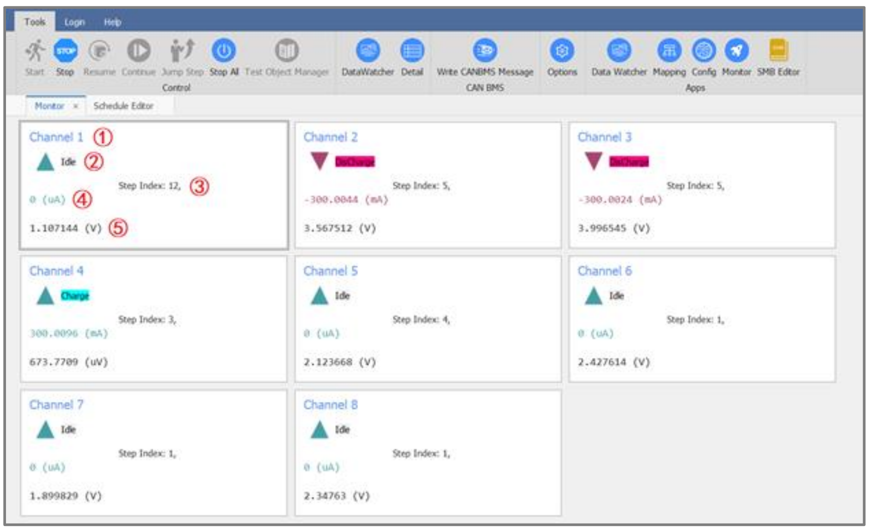


Figure 10-78 Brief View Interface

The Right-click Menu of the Brief View

1) In the Brief View, right-click any channel to view the Brief View Right-click Menu.
2) Options in the menu include Start Channel, Resume Channel, Stop Channel, Open Schedule, Assign Schedule, Clear Schedule.

For specific usage, please refer to the description of Detail View in **10.3 Manage Tests in Detail View**.

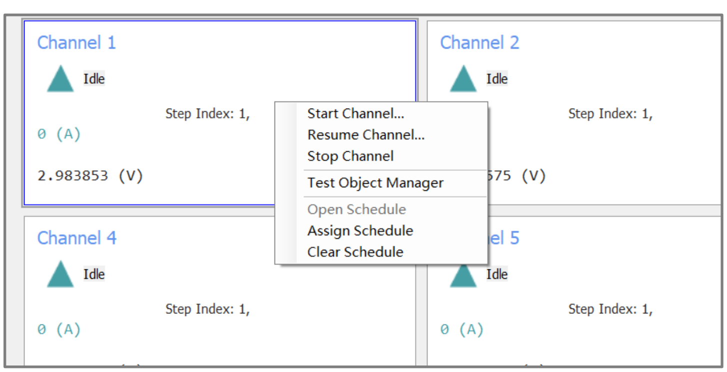


Figure 10-79 The Right-click Menu of the Brief View

10.4.2 Use the Channel View

The Channel View provides detailed real-time data of the selected channel, as well as Smart Battery data when a Smart Battery is being tested.

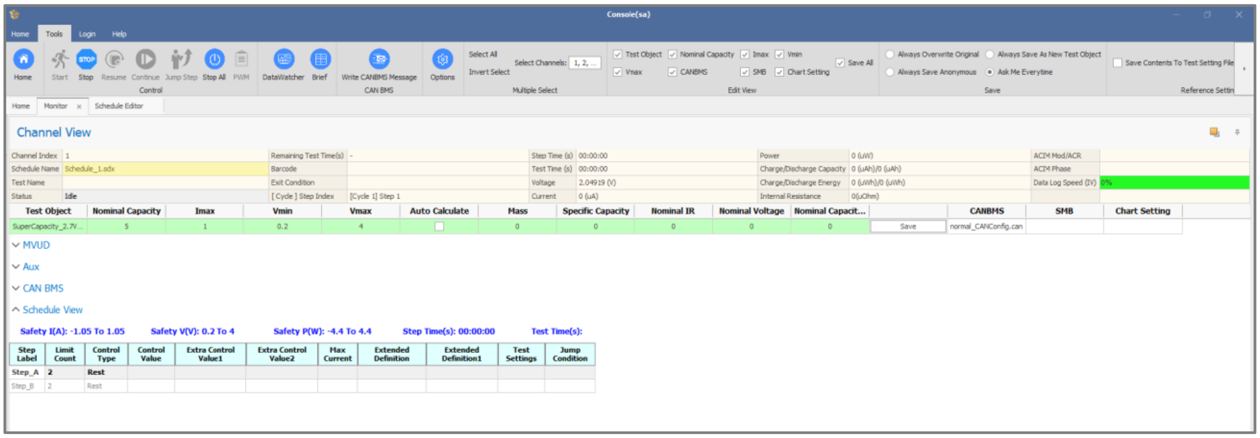


Figure 10-80 Channel View Interface

The Channel View Is used to view channel data (as well as Smart Battery data and CAN data if enabled) on a page.

1) Select a channel number from the Channel Index drop-down list to view the information for the selected channel.

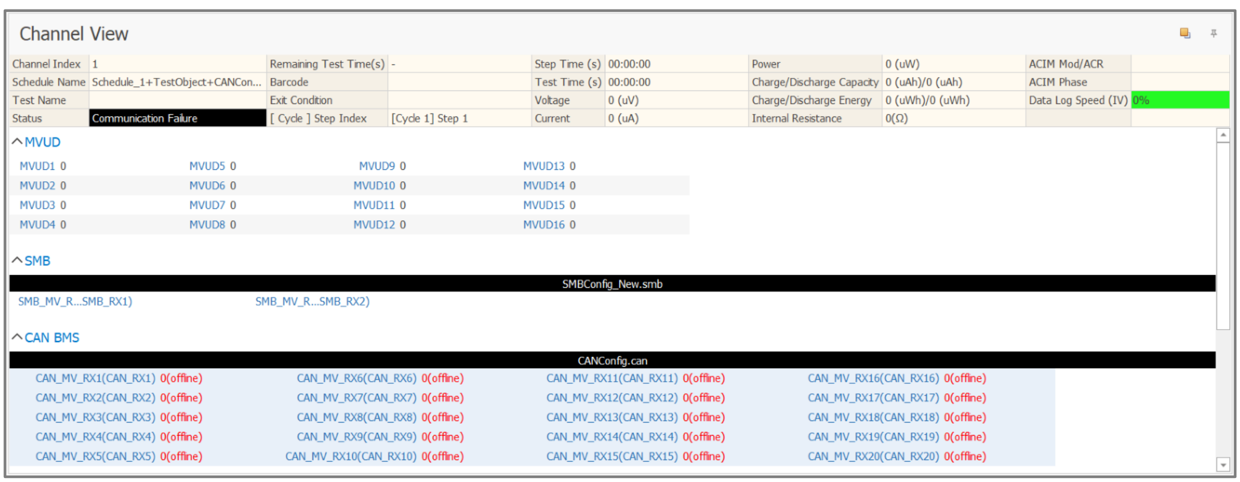


Figure 10-81 View Channel Details in Channel View

2) Click on the section titles in the Channel View to expand or collapse the details of that section.

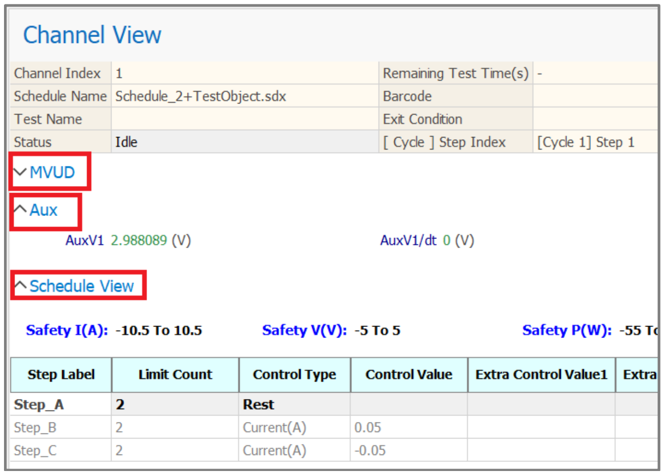


Figure 10-82 Expand and Collapse Channel View Information

3) Right-click the Schedule Name box to open the menu that includes Assign Schedule, Open Schedule, and Clear Schedule.

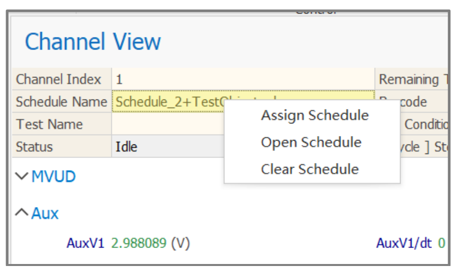


Figure 10-83 Assign, Open, and Clear a Schedule

4) The data field in the blue background represents CAN BMS data. If multiple CAN ports are turned on at the same time, the background colors of the display of different ports are different as shown in Figure 10-84 below.

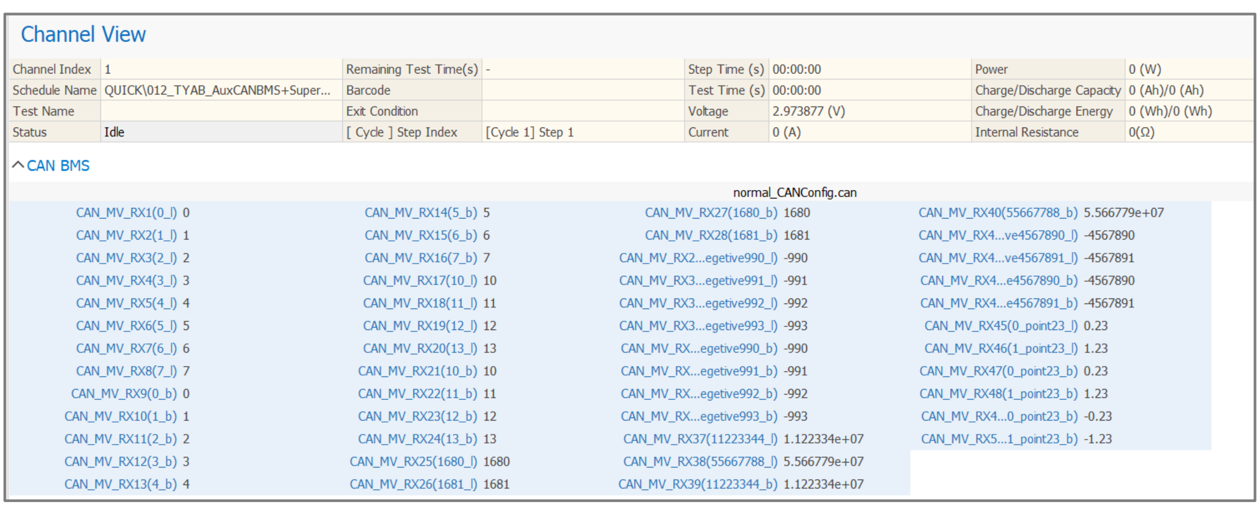


Figure 10-84 CAN BMS Display Area

5) At the bottom of the Channel View, the Schedule View of the Schedule running steps is dynamically displayed, as shown in Figure 10-85 below.
   a) In Schedule View, the header of Schedule View displays the current and voltage safety limit information and the test time (configured on the Global Page of the Schedule File), and the table content is the Step content in the Schedule File.

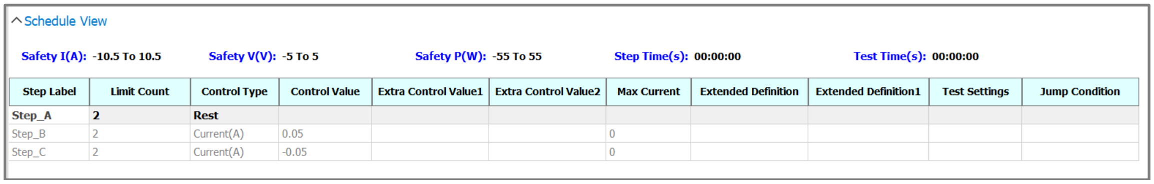


Figure 10-85 Schedule View

10.5 Start Testing

10.5.1 Select the Channel

1) Mits X provides several methods for selecting test channels in the Detail View.
   a) Click and drag the selected channel to select continuous channels.

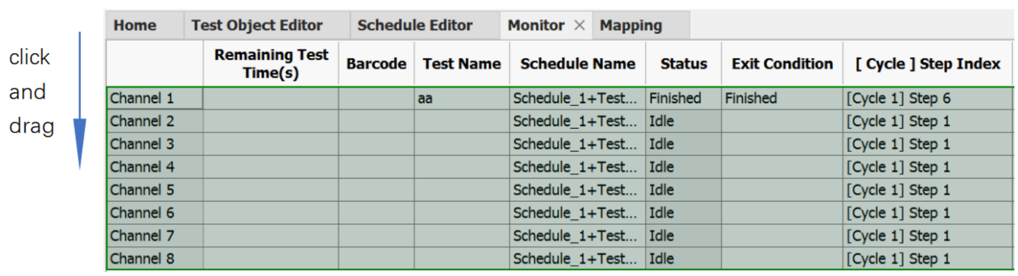


Figure 10-86 Select Continuous Channels

   b) Right-click on the channel name to open a menu with three options for selecting channels.

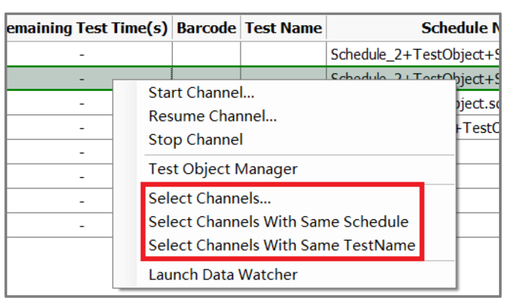


Figure 10-87 Channel Selections Options on the Right-click Menu

   c) Use <Shift> or <Ctrl> to select multiple non-adjacent channels.

2) Right-click the channel index to open DataWatcher and view the test results.
   a) Only one channel can be selected in the Channel View area.
   b) If a channel or channel range is selected in another view, the Channel View area will only reflect the first channel selected.

10.5.2 Open the Channel Test

You can start a test from Detail View, Brief View, or Channel View. In the first two views, multiple channels can be started at the same time. In the Channel View, only the channels displayed in the view can be started.

1) Start a Test from the Detail View Interface.
   a) Click the Start icon on the Detail View Toolbar to open the Start Channel(s) Interface. You can also right-click on the channel you want to start testing and select the "Start Channel" option to start the test.
   b) Enter the necessary information in the Start Channel(s) Interface, including Test Name.
   c) Click the "OK" button on the Start Channel(s) Interface.
      i) The Test Name and recorded dataset from the Test will be stored in the ArbinXMasterInfo.mdf file of the MYSQL server.
      ii) Adding authors and comments will make it easier to locate the Test Name in the database.
2) Start a Test from the Brief View Interface.
   a) Follow the same steps to start a Test from the Detail View Interface, above.

10.6 Update a Schedule Online

Only one channel can perform the Update Schedule Online function while a Test is running.

10.6.1 Update a Single Channel Using a Single Schedule File

The following values can be updated in a Schedule File:

1) The Control Value of a Step
2) The Max Current of a Step
3) One Step/Log Limit of a Step
4) The User Define Safety in Global
   a) Cannot be added but can be modified.
   b) If related to Aux or CAN, this value cannot be modified.
5) Default Data Log Limit
6) dx/dy
7) Clamp Value
   a) If related to CAN, this value cannot be modified.

The following modifications are not allowed and cannot be saved:

1) Modifying the following in a Schedule related to Auxiliary, Control Type, and series and parallel connections:
   a) Test Setting
   b) Formula
   c) Pulse
   d) CV
   e) Global

2) Modifying the following when used by multiple channels:
    a) Simulation Files
    b) Mapping Files
    c) Schedule Files
    d) CAN Files
    e) SMB Files
3) Modifying the following Special Control Types in a Pause state:
    a) ACIM
    b) T_Chamber
    c) External Charge
    d) AC Impedance
    e) Power/Load/Battery/Current Simulation
    f) Current/Voltage Pulse
    g) Adding or deleting a Step or Limit

NOTE: Multiple channels cannot be modified using Update Schedule Online using the same Schedule File.

1) Right-click on the Schedule File that you want to modify.
2) Select the "Open Schedule" option in the menu that appears to open the Schedule File.

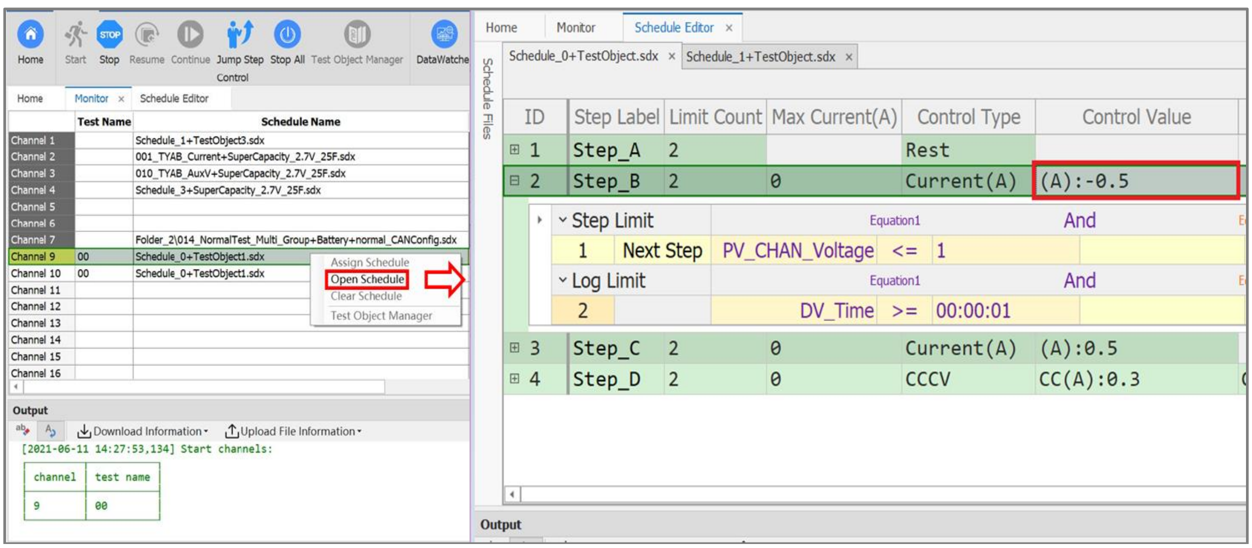


Figure 10-88 Open the Schedule Editor to Modify the Schedule File

3) Modify the Control Value of Step.

4) Click on the “Save” icon in the Schedule Editor Toolbar to save the changes.
   a) The “Output” Interface below will indicate that the modification was successfully saved.

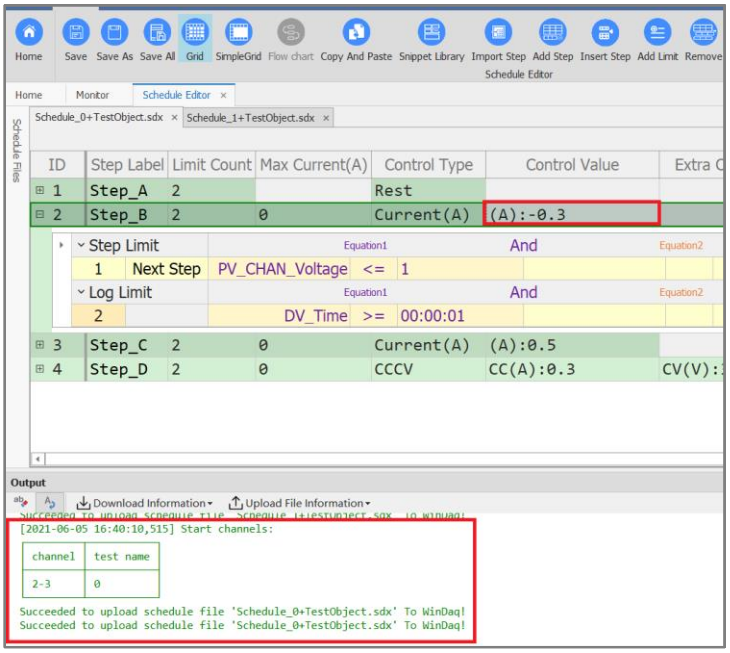


Figure 10-89 Modification Was Successfully Saved

   b) A warning message will appear in the “Output” Interface below if the modification was not successfully saved.

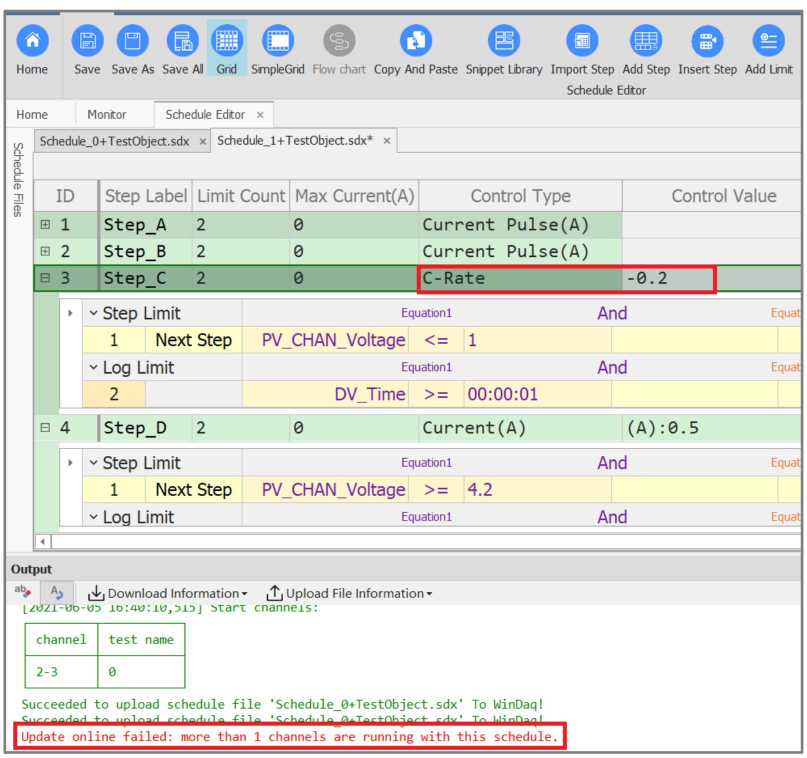


Figure 10-90 Modification Was Not Successfully Saved

10.6.2 Update Two Channels Using Two Schedule Files

The following values can be updated in two different Schedule Files:

1) The Control Value of a Step
2) The Max Current of a Step
3) One Step/Log Limit of a Step
4) The User Define Safety in Global
    a) Cannot be added but can be modified.
    b) If related to Aux or CAN, this value cannot be modified.
5) Default Data Log Limit
6) dx/dy
7) Clamp Value
    a) If related to CAN, this value cannot be modified.

10.6.3 Update Two Channels Connected in Parallel

Update Two Channels that are Parallel in MCU

When at least two channels are connected in parallel, the following elements of the Schedule can be updated:

1) The Control Value of a Step
2) One Step/Log Limit of a Step
3) The User Define Safety in Global
    a) Cannot be added buy can be modified.
    b) If related to Aux or CAN, this value cannot be modified.
4) Default Data Log Limit
5) dx/dy
6) Clamp Value
    a) If related to CAN, this value cannot be modified.

Update Two Channels that are Parallel Between MCUs

When at least two channels are connected in parallel, the following elements of the Schedule can be updated:

1) The Control Value of a Step
2) One Step/Log Limit of a Step
3) The User Define Safety in Global
    a) Cannot be added buy can be modified
    b) If related to Aux or CAN, this value cannot be modified.
4) Default Data Log Limit
5) dx/dy
6) Clamp Value
    a) If related to CAN, this value cannot be modified.

11: DataWatcher

11.1 Introduction to DataWatcher

11.1.1 What is DataWatcher?

DataWatcher is mainly used as an analysis tool for real-time viewing of data, including drawing graph curves and exporting data to files.

11.1.2 The DataWatcher Interface

Open DataWatcher

There are three ways to open DataWatcher:

1) From the Mits X home screen, click on the “DataWatcher” icon.

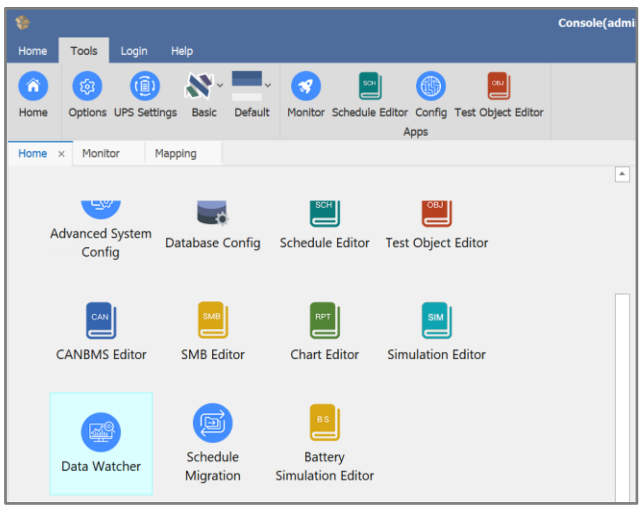


Figure 11-1 DataWatcher icon in Mits X

2) From your desktop, double-click on the DataWatcher icon.

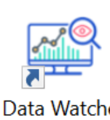


Figure 11-2 DataWatcher Icon

3) From the Monitor Interface, click on the “DataWatcher” icon on the Monitor Toolbar.

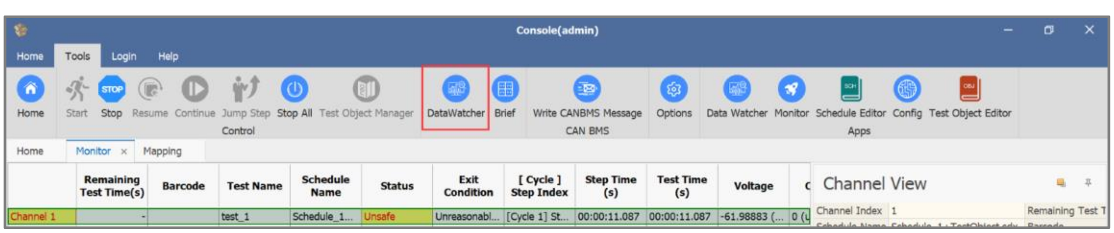


Figure 11-3 The DataWatcher Icon in the Monitor Toolbar

The DataWatcher Interface

There are three main components to the DataWatcher Interface: The Toolbar ①, the Data Source ②, and the Chart Display ③.

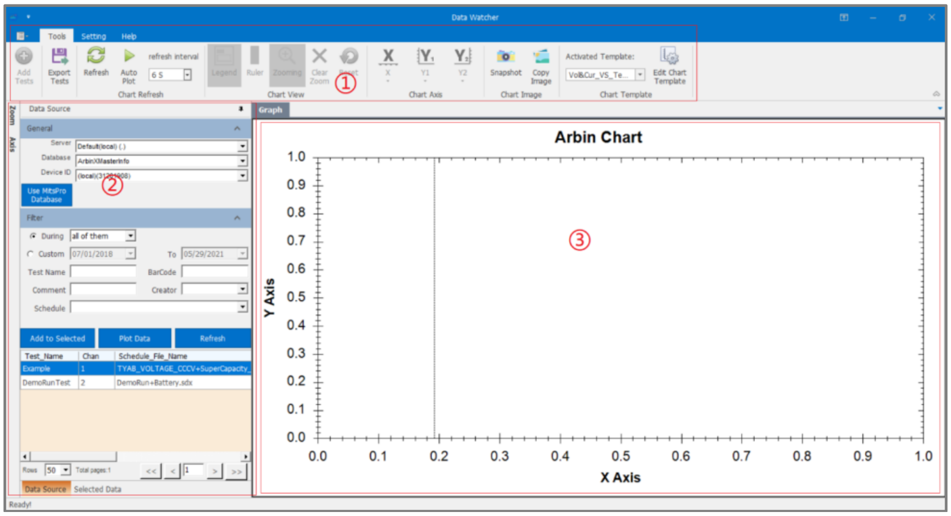


Figure 11-4 DataWatcher interface

1) The DataWatcher Toolbar ① includes the following:
   a) Tools:
      i) **Add Tests** – Add data.
      ii) **Export Tests** – Interface for exporting data.
      iii) **Chart Refresh** – Refresh chart graphics.
      iv) **Chart View** – Manipulate chart graphics.
      v) **Chart Axis** – Select X, Y1, Y2 axis variables.
      vi) **Chart Image** – Generate an image of the chart.
      vii) **Chart Template** – Edit the chart templates.
   b) Setting:
      i) **Database Config** – Configure the database.
      ii) **More Settings** – Configure the chart and export data settings.
   c) Help:
      i) **About** – Information about the Mits X software (version details).

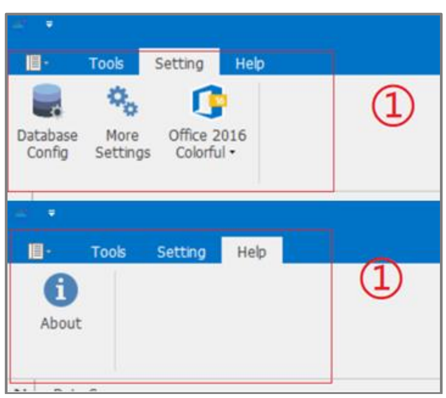


Figure 11-5 DataWatcher Toolbar

2) The Data Source ② includes the following:
   a) **General** – Configure the database for obtaining test data.

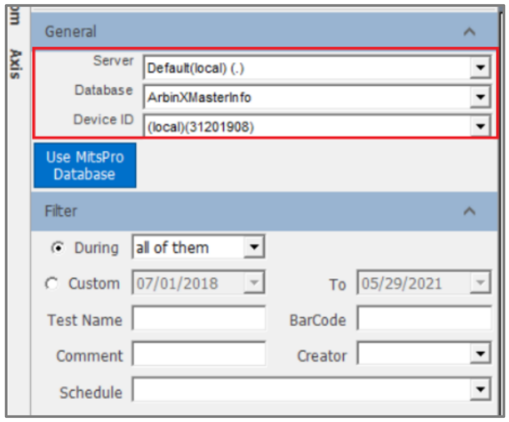


Figure 11-6 General settings

   b) **Filter** – Search test data and display test information.
3) The Chart Display ③ shows a chart of the selected data.

11.2 Manage Test Data with DataWatcher

11.2.1 Search for a Test Using Filters

Below the General setting in Data Source, the Filter section allows you to search for a test by various features:

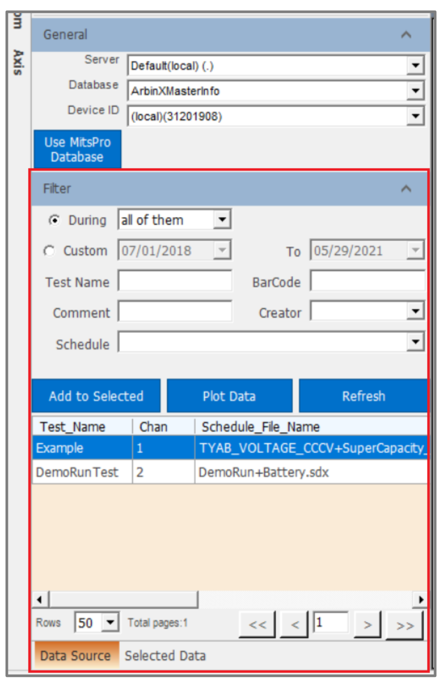
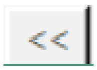
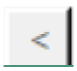
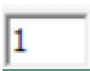
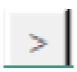


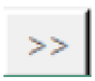
Figure 11-7 The Search Filters

1) **During** – Duration, which includes All-Time, recent 3 days, recent 1 week, recent 2 weeks, recent 3 weeks, recent 1 month and recent 3 months.
2) **Custom** – Specify the date and time period.
3) **TestName** – Test name.
4) **Barcode** –– Barcode.
5) **Comment** – Description.
6) **Creator** – Creator of the test.
7) **Schedule** – Test schedule.
8) **Add to Selected:** Add the test in the Data Source panel to the Selected Data panel.
9) **Plot Data** – Generate chart display of test data in the data source panel.
10) **Refresh** – Refresh the test of the data source panel.
11) **Rows** – Number of tests shown on one page.
12) 

– First page.
13) 

– Previous page.
14) 

– Designated page.
15) 

– Next page.
16) 

– Last page

11.2.2 Export MitsX Test Data

Begin Test Data Export from the Data Source Panel

1) Open the main DataWatcher page.
2) Display the Data Source panel in one of two ways:
   a) Click on the "Add Tests" button.
   b) Click on the "Data Source" panel title.
3) Select the test name for the data you want to export in the area marked with ① in Figure 11-8 below.
   a) If some tests have the same test name, use the channel numbers and starting test times to select the desired test.
   b) You can select one test at a time or select multiple tests at the same time using <Ctrl> or <Shift>.
4) Click on the Export Tests button marked with ② on the DataWatcher Toolbar to open the Export dialog box.

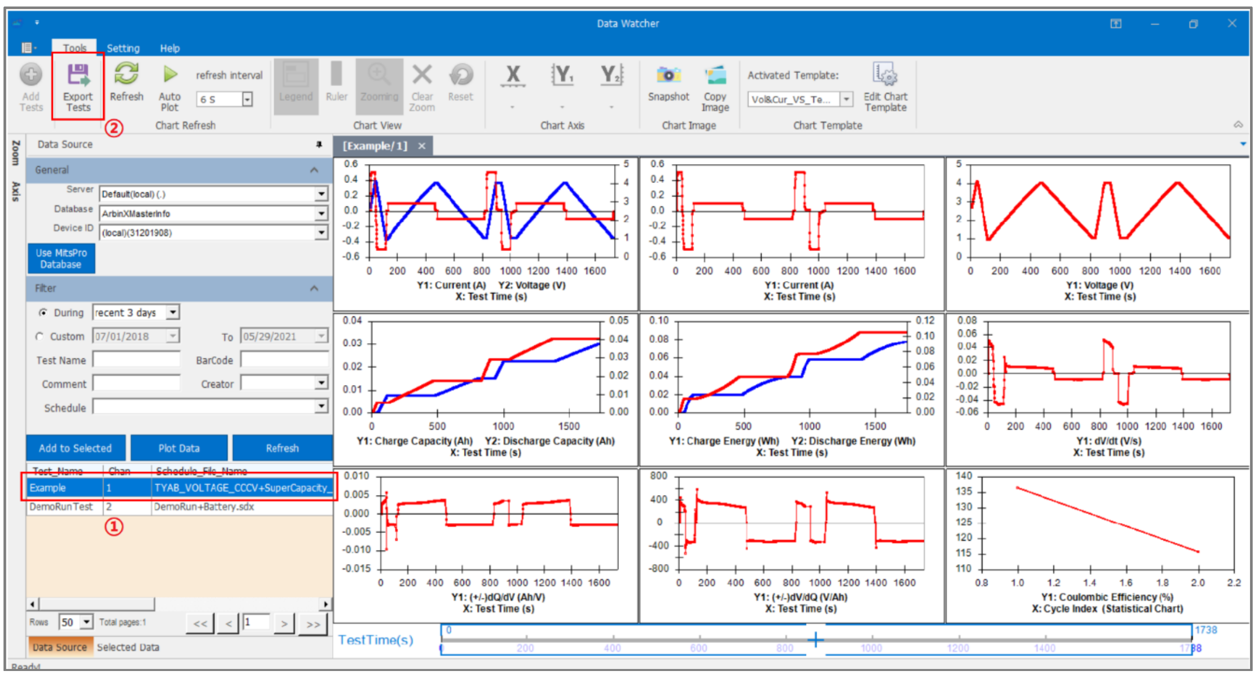


Figure 11-8 Data Source Panel

Begin Test Data Export from the Selected Data Panel

1) Switch from the Data Source tab to the Selected Data tab at the bottom of the DataWatcher interface.
2) Choose the tests for export in one of two ways:
   a) Click on the “Export Tests” button in the DataWatcher toolbar to open the Export dialog box and export data from the tests in the Selected Test panel.
   b) In the Selected Test panel, right-click on the test you want to export and select “Export” in the menu to open the Export dialog box.

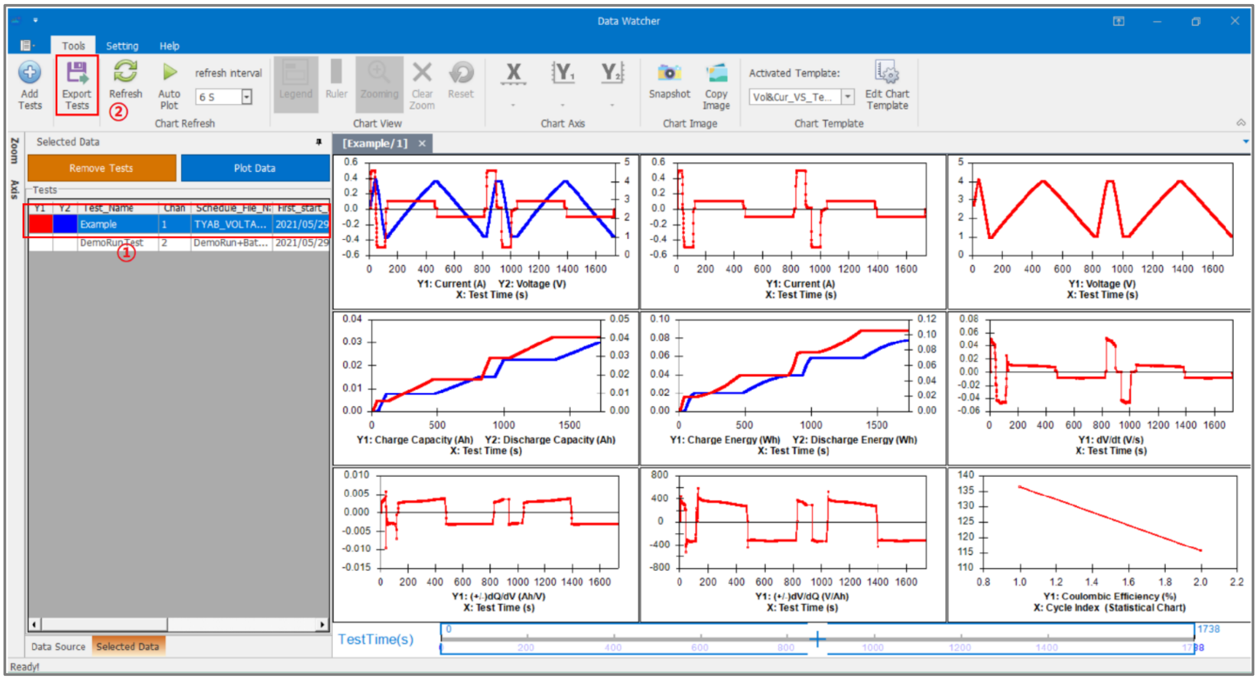


Figure 11-9 Selected Data Panel

The Export Dialog Box

In the Export dialog box, you set up the data to export in the way that you need.

1) Make sure the desired test is displayed in the Selected Data List on the right of the Export dialog box.
2) Select the appropriate settings and filters for the export (see list of filters below).
3) Click the “Export to Files” button to get an estimate the number of exported data rows and the time for the export.
4) Click the “Yes” button to begin the export and save the exported data as either an Excel file or CSV (depending on the settings you choose) with a file name that combines the test name and channel index.
5) In the Interface that comes up after export, you can open the exported file to check the data or open the folder where the exported data is stored (Figure 11-14).

Export Filter Options

1) **File Types** – Check To Excel option button (default), and the file extension will denote the exported file *.xlsx, Check To CSV option button and the exported file will be denoted by the file extension *.csv.
2) To export all the data points of selected tests, click the **All Option** button(default).
3) To export data from a selected number of contiguous cycles, click **From Cycle** option button. Enter the beginning cycle and ending cycle numbers in the From and To boxes. If **CyclePerFile** is checked and is set to a non-zero integer, for example 10, then the exported data will be saved in a series of separate files in sets of 10 cycles.
4) To export data from a test time to another testing time, click **From Test Time** option button. Then, enter the selected beginning test time and ending test time in the From and To boxes.
5) Click the **Percentage of Data Point** option button to export data based on a certain percentage of channel data points. Then enter the desired percentage value in the From and To boxes. (e.g., If the whole results file contains 1000 points and you enter from 5 to 10 in the percentage boxes, then DataWatcher will export data of the points from 50th point to 100th).
6) To export data based on a percentage of test time, click the **Percentage of Test Time** option button. Then enter the desired percentage value in the From and To boxes. (e.g., If the whole results file contains 1000 seconds of test time and you enter from 5 to 10 in the percentage boxes, then DataWatcher will export data of the points whose test times are between 50 seconds and 100 seconds.)
7) To export certain types of data along with the default normal data (current, voltage, capacity, energy, internal resistant, and so on), check the appropriate checkboxes in **Data Filter**, such as **Statistics by Cycle** and **Statistics by Step**, **Auxiliary Data**, **CAN BMS Data**, and **SMB BMS Data**. If nothing is selected, only the default normal data will be exported. When CAN or SMB’s **Single Sheet** box is checked, CAN or SMB data will be exported in a single sheet in excel or a single CSV file.
8) To export additional data such as **TC_Counter** and **MV_UD** (for Mits8 only), go to the <**Additional Filter**> tab and select the appropriate item.
9) To set up the number format in the exported data, go to <**Numeric Format for Mits8 only**> tab and select the appropriate format.

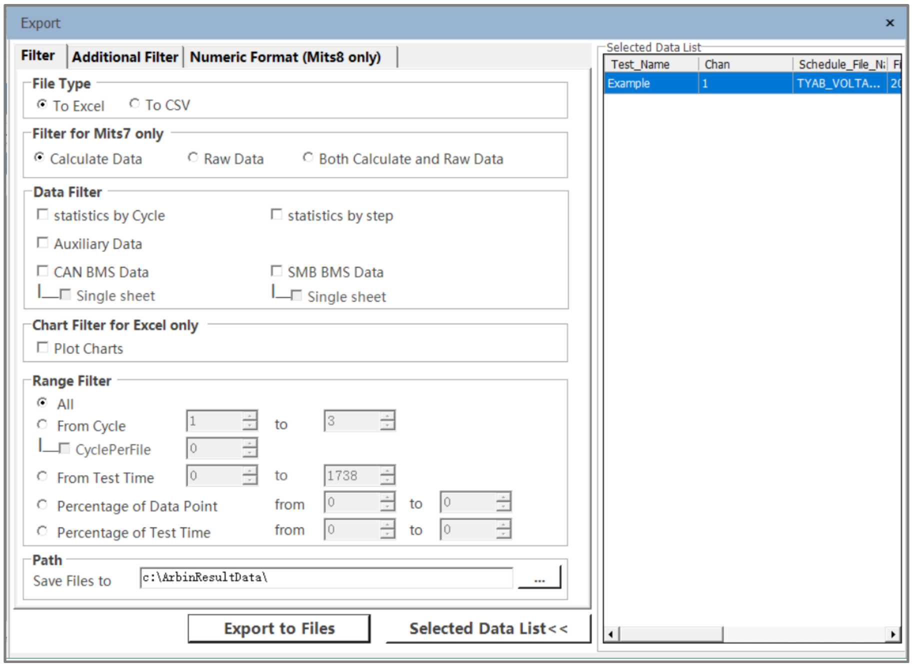


Figure 11-10 Filter Page of Export Dialog

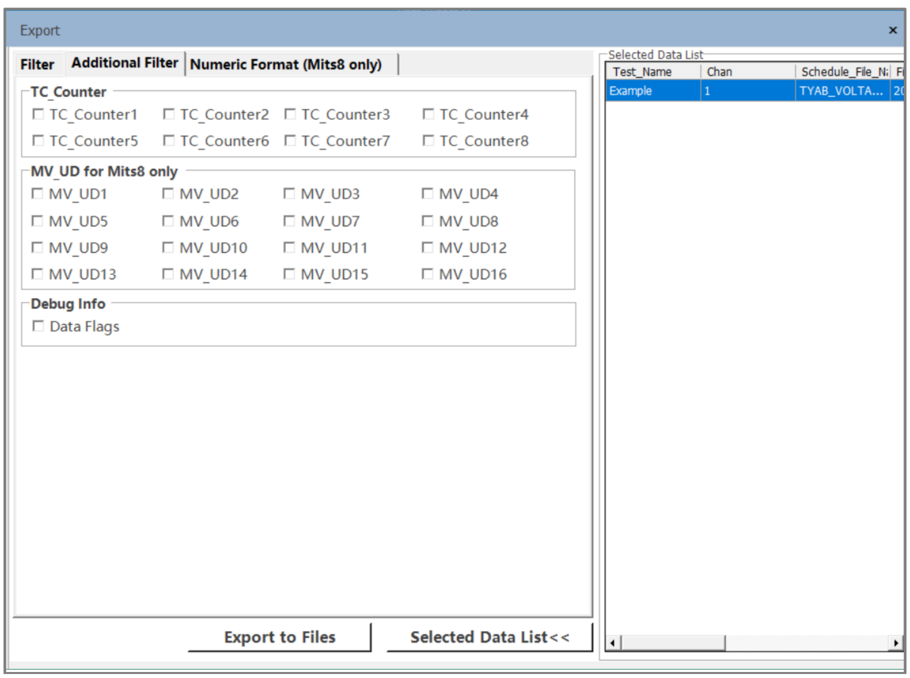


Figure 11-11 The Additional Filter Page of the Export Dialog

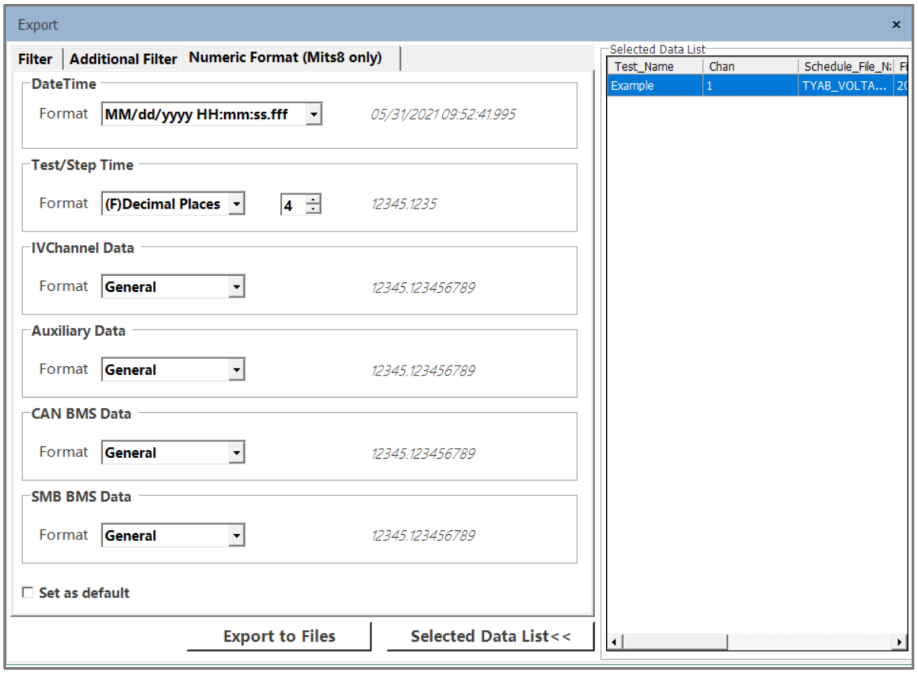


Figure 11-12 The Numeric Format Page of the Export Dialog

Export Excel Data

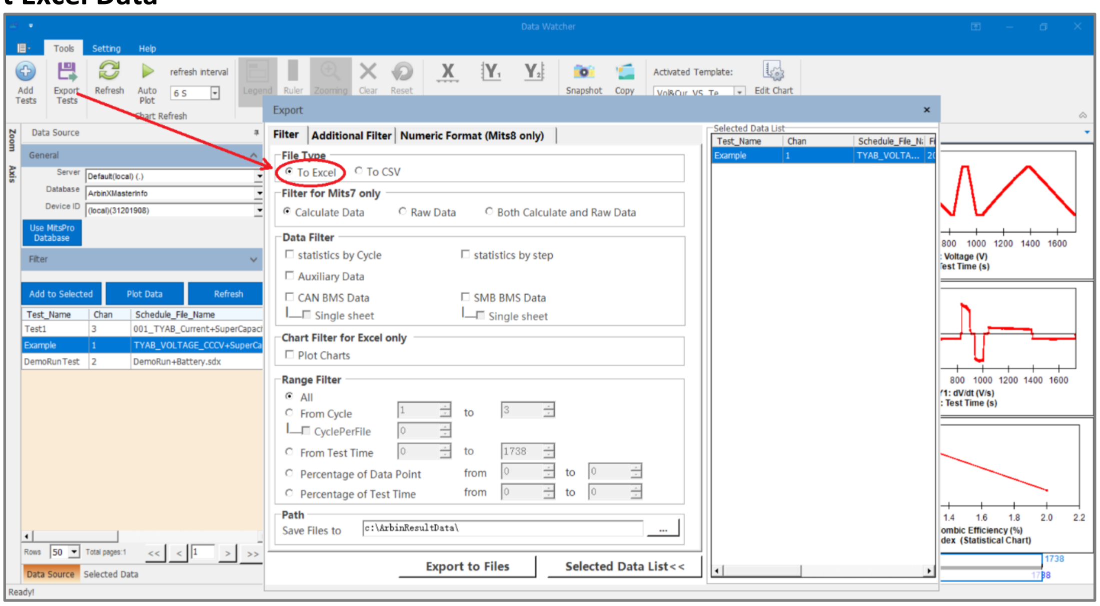


Figure 11-13 Select "To Excel"

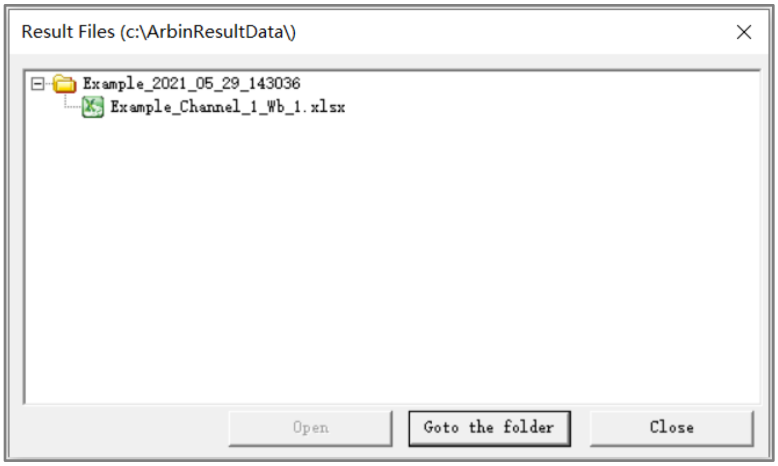


Figure 11-14 Result File in Excel Format

Data_Point	Date_Time	Test_Time(s)	Step_Time(s)	Cycle_Index	Step_Index	Current(A)	Voltage(V)	Power(W)	Charge_Capacity(Ah)	Discharge_Capacity(Ah)	Charge_Energy(Wh)	Discharge_Energy(Wh)
1	05/29/2021 14:30:37.625	1.0005	1.0005	1	1	0	2.684353	0	0	0	0	0
2	05/29/2021 14:30:38.626	2.0009	2.0009	1	1	0	2.68427	0	0	0	0	0
3	05/29/2021 14:30:39.625	3.0001	3.0001	1	1	0	2.684299	0	0	0	0	0
4	05/29/2021 14:30:40.625	4.0005	4.0005	1	1	0	2.684359	0	0	0	0	0
5	05/29/2021 14:30:41.625	5.0002	5.0002	1	1	0	2.68433	0	0	0	0	0
6	05/29/2021 14:30:42.626	6.0009	6.0009	1	1	0	2.68431	0	0	0	0	0
7	05/29/2021 14:30:43.625	7.0002	7.0002	1	1	0	2.684321	0	0	0	0	0
8	05/29/2021 14:30:44.625	8.0002	8.0002	1	1	0	2.684399	0	0	0	0	0
9	05/29/2021 14:30:45.625	9.0001	9.0001	1	1	0	2.684261	0	0	0	0	0
10	05/29/2021 14:30:46.625	10.0005	10.0005	1	1	0	2.684293	0	0	0	0	0
11	05/29/2021 14:30:46.625	10.0008	10.0008	1	1	0	2.684293	0	0	0	0	0
12	05/29/2021 14:30:47.657	11.0322	1.0002	1	2	0.2271745	2.753932	0.6256231	9.82271E-05	2.22228E-07	0.000268407	5.96524E-07
13	05/29/2021 14:30:48.657	12.0323	2.0003	1	2	0.3887675	2.803968	1.0900916	0.000237364	2.22228E-07	0.000655091	5.96524E-07
14	05/29/2021 14:30:49.657	13.0326	3.0006	1	2	0.4546475	2.853225	1.2972116	0.000375807	2.22228E-07	0.001046699	5.96524E-07
15	05/29/2021 14:30:50.657	14.0325	4.0005	1	2	0.4814135	2.901764	1.3969484	0.000515027	2.22228E-07	0.001447312	5.96524E-07
16	05/29/2021 14:30:51.657	15.0324	5.0004	1	2	0.4924188	2.950076	1.4526729	0.000654234	2.22228E-07	0.001854645	5.96524E-07
17	05/29/2021 14:30:52.657	16.0327	6.0007	1	2	0.4968898	2.997566	1.48946	0.000792746	2.22228E-07	0.002266582	5.96524E-07
18	05/29/2021 14:30:53.657	17.0326	7.0006	1	2	0.4987284	3.044919	1.5185876	0.000931869	2.22228E-07	0.002686933	5.96524E-07
19	05/29/2021 14:30:54.657	18.0323	8.0003	1	2	0.4994752	3.091519	1.5441371	0.001070312	2.22228E-07	0.003111727	5.96524E-07
20	05/29/2021 14:30:55.657	19.0326	9.0006	1	2	0.4997821	3.137864	1.5682483	0.001209449	2.22228E-07	0.003545123	5.96524E-07

Figure 11-15 Result Data

Export CSV Data

An important advantage of exporting data to a CSV file is that it takes less time than an Excel file exporting millions of data. If the computer has a good hardware performance, it can export 60,000 to 100,000 data per second. If the data is exported as an Excel file, it will be about 10,000 data per second. More importantly, users can open CSV files through Excel.

1) Click the "To CSV" button in the Export dialog box.
2) Select the other filters and options for the export as usual, including where you want the file to be saved.
3) Click the "Export to Files" button to save the CSV file in the ArbinResultDataCSV folder in the default path.
4) In the Interface that comes up after export, you can open the exported file to check the data or open the folder where the exported data is stored (Figure 11-14).

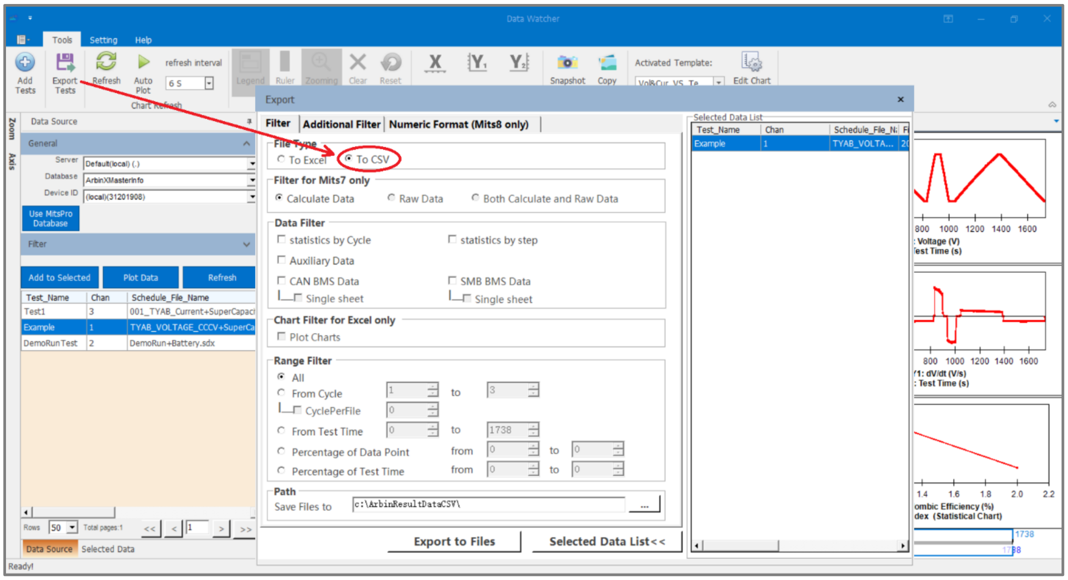


Figure 11-16 Check To CSV

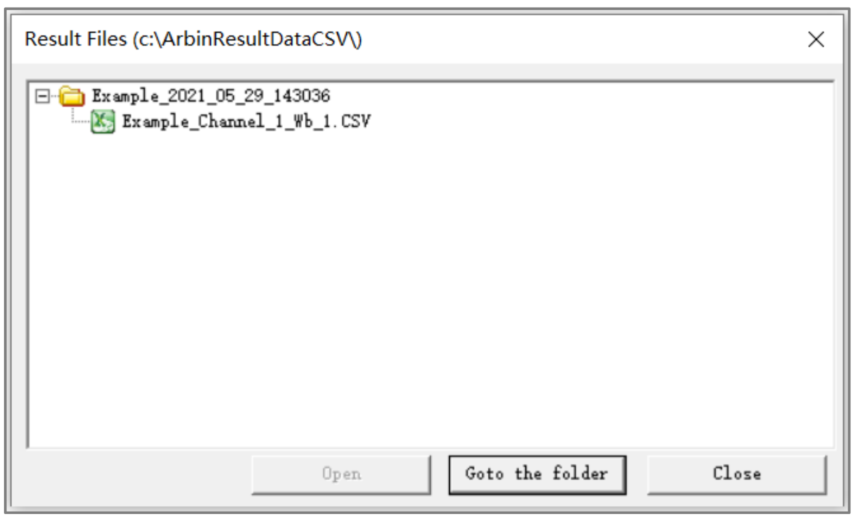


Figure 11-17 CSV Format Result File

Data_Poin	Date_Time	Test_Time	Step_Time	Cycle_Inde	Step_Inde	Current(A	Voltage(V	Power(W)	Charge_Ca	Discharge	Charge_Er	Discharge	ACR(Ohm	dV/dt(V/s	Internal_R	dQ/dV(Ah	dV/dQ(V/Ah
1	05/29/202	1.0005	1.0005	1	1	0	2.684353	0	0	0	0	0					
2	05/29/202	2.0009	2.0009	1	1	0	2.68427	0	0	0	0	0					
3	05/29/202	3.0001	3.0001	1	1	0	2.684299	0	0	0	0	0					
4	05/29/202	4.0005	4.0005	1	1	0	2.684359	0	0	0	0	0					
5	05/29/202	5.0002	5.0002	1	1	0	2.68433	0	0	0	0	0					
6	05/29/202	6.0009	6.0009	1	1	0	2.68431	0	0	0	0	0					
7	05/29/202	7.0002	7.0002	1	1	0	2.684321	0	0	0	0	0					
8	05/29/202	8.0002	8.0002	1	1	0	2.684399	0	0	0	0	0					
9	05/29/202	9.0001	9.0001	1	1	0	2.684261	0	0	0	0	0					
10	05/29/202	10.0005	10.0005	1	1	0	2.684293	0	0	0	0	0					
11	05/29/202	10.0008	10.0008	1	1	0	2.684293	0	0	0	0	0		0	0	0	0
12	05/29/202	11.0322	1.0002	1	2	0.227175	2.753932	0.625623	9.82E-05	2.22E-07	0.000268	5.97E-07		0.050178		0.00265	436.3382
13	05/29/202	12.0323	2.0003	1	2	0.388768	2.803968	1.090092	0.000237	2.22E-07	0.000655	5.97E-07		0.049334		0.002793	358.6801
14	05/29/202	13.0326	3.0006	1	2	0.454648	2.853225	1.297212	0.000376	2.22E-07	0.001047	5.97E-07		0.048967		0.002819	352.8691
15	05/29/202	14.0325	4.0005	1	2	0.481414	2.901764	1.396948	0.000515	2.22E-07	0.001447	5.97E-07		0.04848		0.002862	350.6161
16	05/29/202	15.0324	5.0004	1	2	0.492419	2.950076	1.452673	0.000654	2.22E-07	0.001855	5.97E-07		0.047824		0.002909	346.3509
17	05/29/202	16.0327	6.0007	1	2	0.49689	2.997566	1.48946	0.000793	2.22E-07	0.002267	5.97E-07		0.047176		0.002933	341.8911
18	05/29/202	17.0326	7.0006	1	2	0.498728	3.044919	1.518588	0.000932	2.22E-07	0.002687	5.97E-07		0.046859		0.002953	339.9532
19	05/29/202	18.0323	8.0003	1	2	0.499475	3.091519	1.544137	0.00107	2.22E-07	0.003112	5.97E-07		0.046154		0.002992	335.6597
20	05/29/202	19.0326	9.0006	1	2	0.499782	3.137864	1.568248	0.001209	2.22E-07	0.003545	5.97E-07		0.045655		0.00303	332.3785

Figure 11-18 Result Data

Default Names for Export Files

For the test named DemoRunTest in Channel 3, the Excel file name in the default.xls file is “DemoRunTest_Channel_2_Wb_1.”

11.2.3 View the Statistics Report

The statistical data comes from the last data point of each cycle or step and is easily viewed in statistical reports.

1) Open the Selected Data panel of the DataWatcher home screen.
2) Right-click on the test or tests for which you want to view a statistical report.
3) In the menu that appears, select the “Statistical Report” option (Figure 11-19).

If multiple tests are selected, multiple pages will be displayed in statistical report Interface that appears. Each page provides the statistical data of a different selected test, and you can change the page by clicking on the page headers (Figure 11-20).

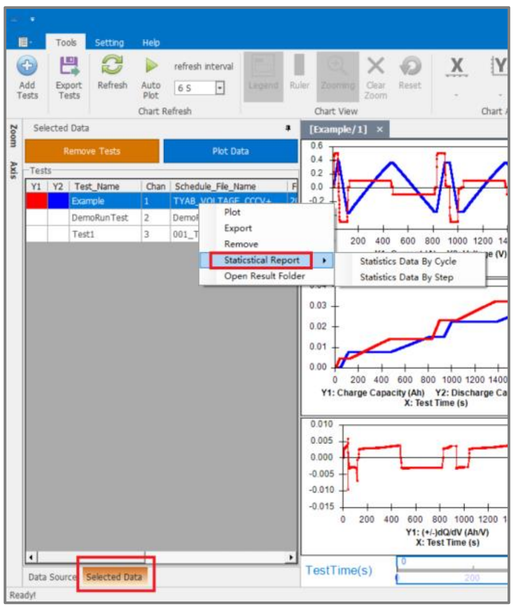


Figure 11-19 Open the Statistics Report Interface

View Arbin Data_StatisticByStep

Example-chan-1-testId-2 | DemoRunTest-chan-2-testId-1

Date_Time	Test Time (s)	Step Time (s)	Cycle Index	Step Index	TC_Counter1	TC_Counter2
05/29/2021 14:30:46.626	10.001	10.001	1	1	0	0
05/29/2021 14:31:21.965	45.34	35.308	1	2	0	0
05/29/2021 14:32:37.162	120.538	75.192	1	3	0	0
05/29/2021 14:32:47.198	130.574	10.001	1	4	0	0
05/29/2021 14:38:28.908	472.284	341.678	1	5	0	0
05/29/2021 14:38:38.945	482.32	10.001	1	6	0	0
05/29/2021 14:44:20.172	823.548	341.195	1	7	0	0
05/29/2021 14:44:30.214	833.59	10.001	2	1	0	0
05/29/2021 14:46:14.789	938.164	104.544	2	2	0	0
05/29/2021 14:47:53.848	1037.224	99.054	2	3	0	0
05/29/2021 14:48:03.884	1047.259	10.001	2	4	0	0
05/29/2021 14:53:43.231	1386.606	339.314	2	5	0	0
05/29/2021 14:53:53.266	1396.641	10.001	2	6	0	0
05/29/2021 14:59:33.946	1737.321	340.649	2	7	0	0

Figure 11-20 Interface Showing Step-By-Step Statistics

11.2.4 Additional Data Management Features

Use Multi-Channel Plotting

In addition, if you want to view a chart containing multiple tests, you can press <Ctrl> or <Shift> to select multiple tests and then click the Plot Data button.

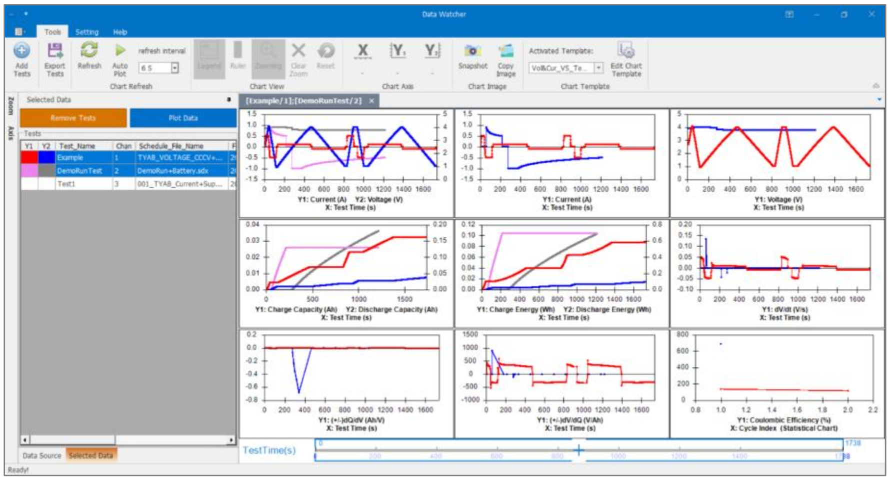


Figure 11-21 Multi-Channel Plotting

Use the Multiple Tab Page Feature

This new feature of DataWatcher allows users to have multiple tabs to keep plotting records. When the user selects a test that has never been plotted before, a new tab page will be generated to display the chart, and the header name of the tab page will be named in the format of "[test name/channel number]."

1) Click on the header of the tabs to switch between the different tabs.
2) Click on the "x" close button on the right side of the header or right-click a header and select "Close" in the menu that appears to close a tab.
3) Drag a tab out of the main DataWatcher Interface or right-click the header and select "Float" in the menu that appears to make the tab an independent floating Interface.
4) Floating tabs can be dragged and dropped back into the main DataWatcher interface.

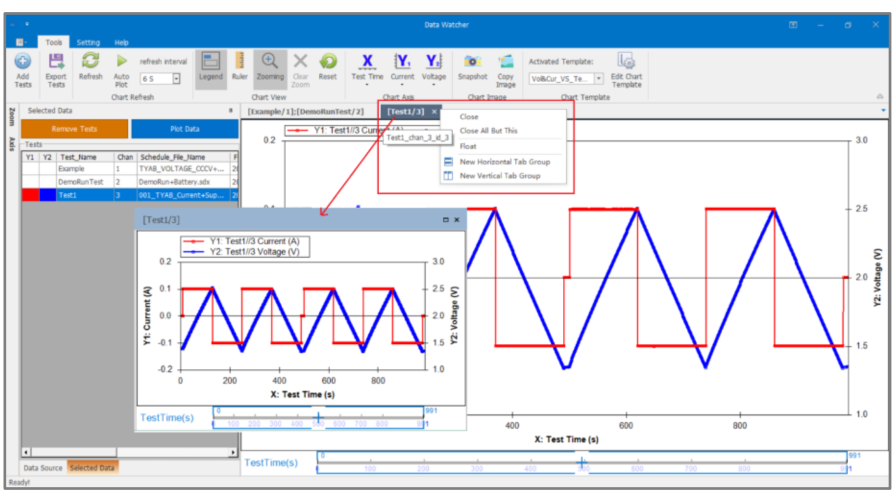


Figure 11-22 DataWatcher Multiple Tab Display and Features

11.3 Manage Data Display with DataWatcher

Preview Mode is another new feature for Mits X. When the Plot Data button is clicked, it will draw 2 to 9 charts containing different combinations of X, Y1, and Y2 coordinate axes at the same time when plotting on the tab page. The number of charts in the Preview Mode and the coordinate axis combination of each icon is determined by the chart template selected in the drop-down list in the upper toolbar.

In this mode, the buttons in the Chart View group of the upper toolbar and the Zoom and Axis sidebars of the DataWatcher home screen are disabled. Double-click a chart, the Preview Mode will change to a single chart, and the buttons and sidebars that are disabled in the preview mode will restore their functions. To return to the preview mode from a single graph, double-click anywhere in the graph.

Figure 11-23 Icon Template Drop-Down List and Top Function Buttons that Are Disabled in Preview Mode

11.3.1 Manage Chart Templates

Add, Edit, and Delete Chart Templates

1) Click the “Edit Chart Template” button in the DataWatcher toolbar to open the “Arbin Chart Template Editor” Interface.
2) The Chart Files list on the left of this Interface will display all the chart template files (*.cht) and allow you to manage these files. The selected template file is displayed on the right.
3) Each template file has 3 tabs for you to edit.

Preview Mode Chart Operations

1) In Total Number of Chart, type any integer between 1 and 9 to set the number of charts in Preview Mode.
2) Click to select a chart for the following operations:
   a) Change the axis details.
   b) Switch to the statistical chart.

3) Set the chart as the default starting chart by using the “Set as Starting Chart When Plotting” option.
    a) This chart will be displayed first when you click the “Plot Data” button, bypassing the preview chart.
    b) The corresponding function keys and panels will be based on this starting chart.
    c) If the Total Number of Chart is set to 1, the checkmark box for “Set as Starting Chart When Plotting” will be selected automatically.
4) Set the current chart as a statistical chart by selecting the “Switch to Statistical Axis” checkmark box. The axis information of the drop-down list of X, Y1, and Y2 will become the statistical type.
5) Double-click on the chart area to switch back to Preview Mode.

Set the Axis Parameters

1) Click on the Axis tab in the sidebar of DataWatcher.
    a) The X-Axis is in the dropdown list.

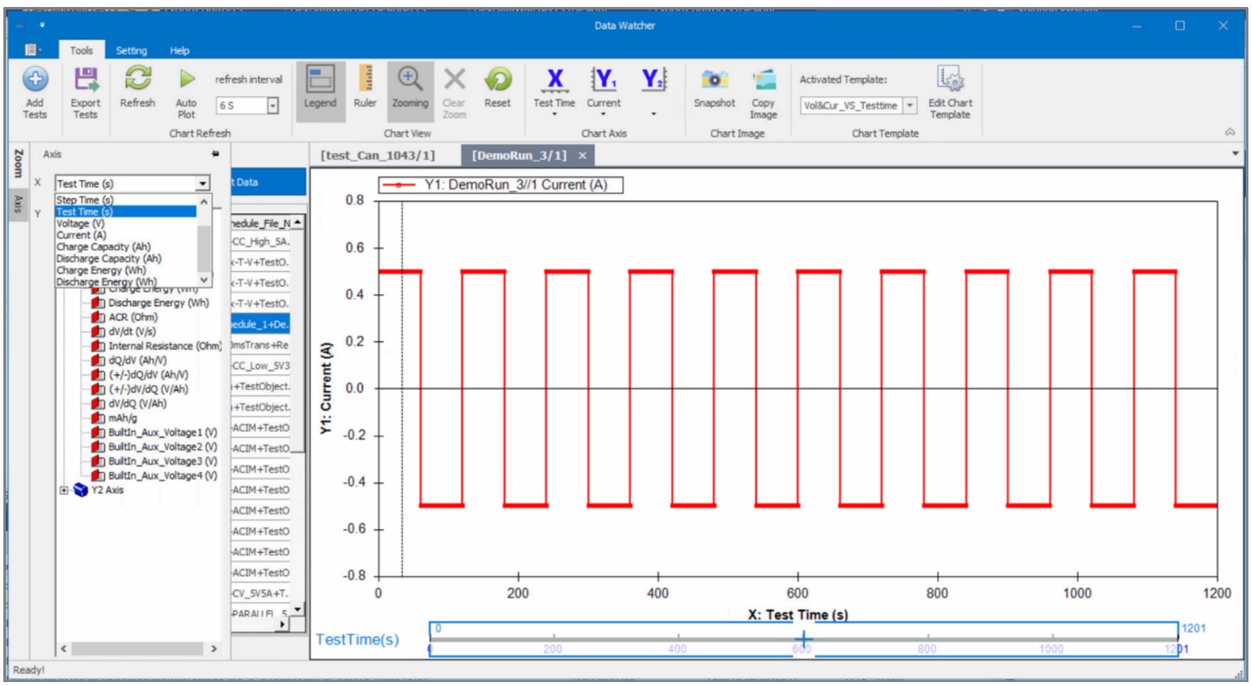


Figure 11-24 Select the X-Axis

a) Select the Y1-Axis.

   i) The Y1 and Y2 Axes are displayed in the file directory of the Axis sidebar.

   ii) The selected parameters of the Y1 Y2 axes are indicated by icons, as shown in Figure 11-25.

   iii) Other parameters display different icons.

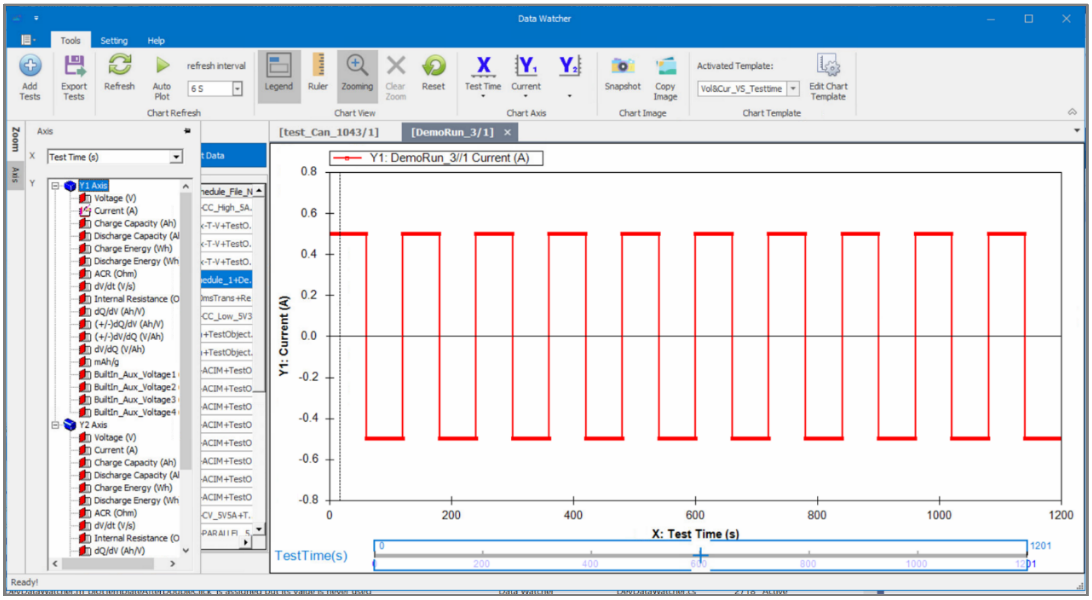


Figure 11-25 Select the Y1-Axis

b) Once the X-Axis and a Y-Axis are selected, a chart will be displayed on the right side of the Interface.

c) Select the Y2-Axis, as shown in Figure 11-26.

   i) For example, when voltage is selected for the Y2 axis, a curve (voltage) will be automatically added to the graph.

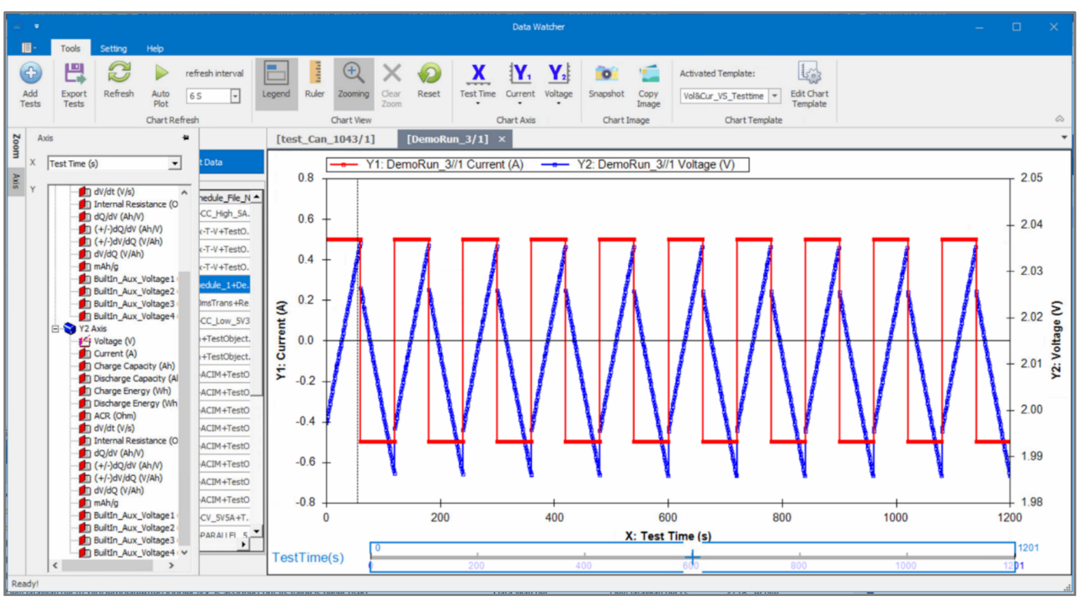


Figure 11-26 Voltage Selected as the Y2 Coordinate Axis

NOTE: The Axis tab is not available in Preview Mode.

You can also select the coordinate axes from the top toolbar.

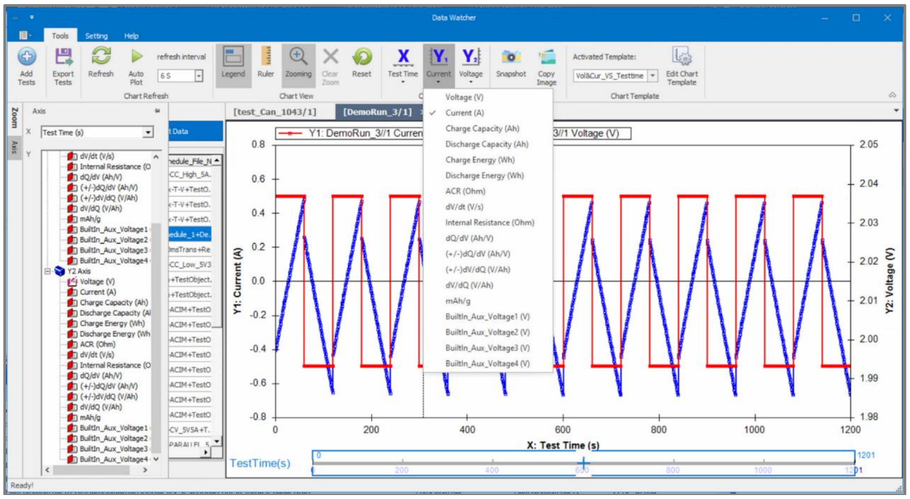


Figure 11-27 The Axis Drop-Down Box in the Top Menu Bar

Configure the Axis Styles

In The Chart Template Editor, you can set the display of the X, Y1, and Y2 Axes.

1) Click the Axes Tab in the Arbin Chart Template Editor.
2) Configure the Axis Display Options (Figure 11-28).
   a) X, Y1, and Y2 Axis Title Fonts
   b) X, Y1, and Y2 Grid Line Major and Minor Ticks

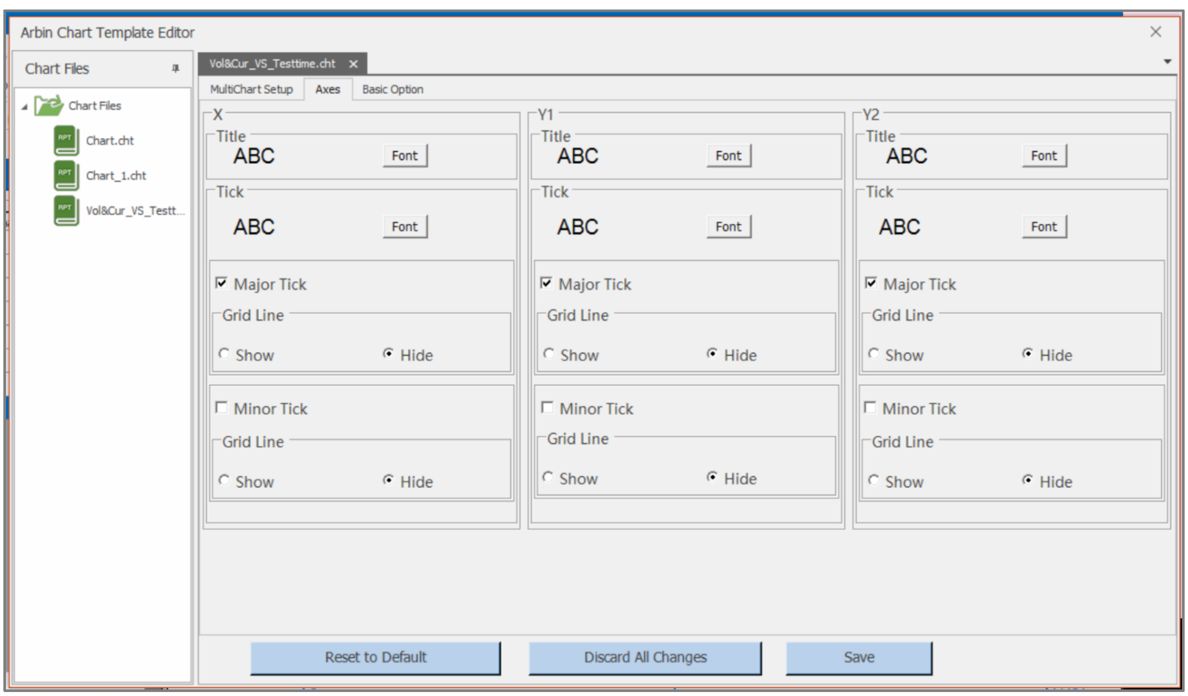


Figure 11-28 Set the Axis Display Options

Configure the Axis Settings Basic Chart Styles

1) Click the Basic Options Tab.
2) Configure the Display Options (Figure 11-29).
   a) Chart Legend Font and Position
   b) Style and Size of Data Points
   c) Style and Size of Line Between Data Points
   d) Background Color of the Chart Area
   e) Background Color Outside of the Chart Area

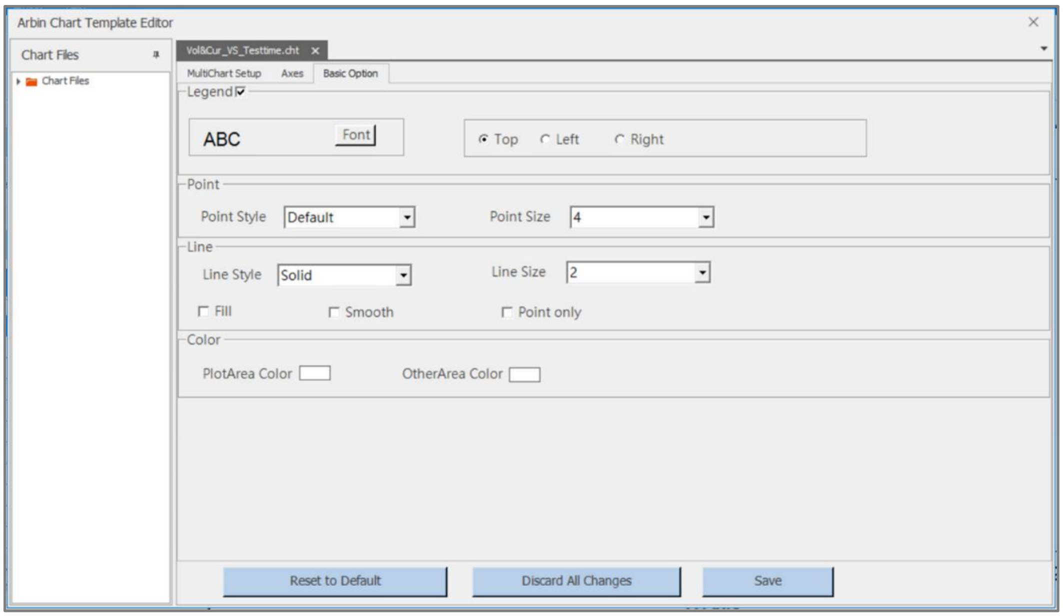


Figure 11-29 Set the Basic Options Display Options

In addition, users can create chart templates in the Mits X Console (Figure 11-30, Figure 11-31).

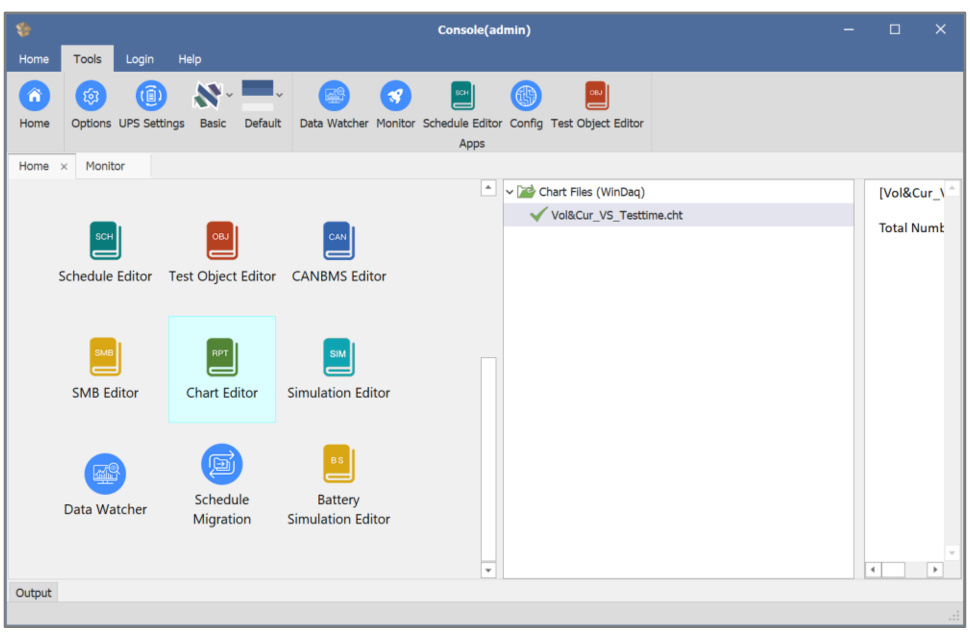


Figure 11-30 The Chart Editor Icon in the Home Tab of the Console

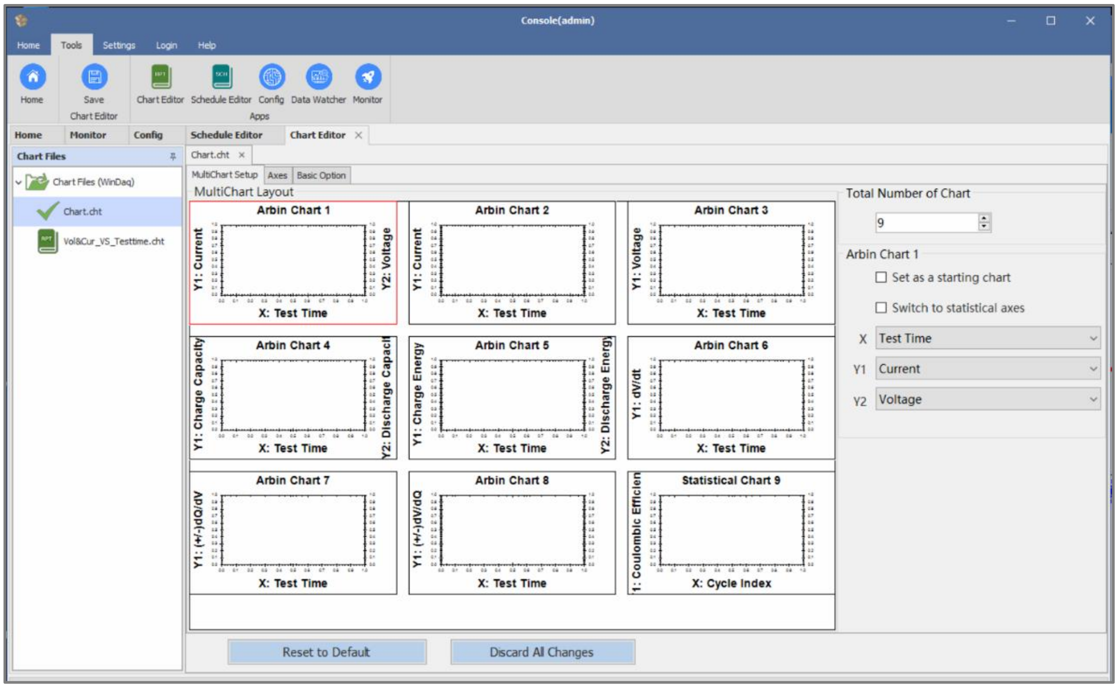


Figure 11-31 Generate Chart Templates in the Chart Editor in the Mits X

For example, Figure 11-32 below shows a chart with a custom axis title font and scale style.

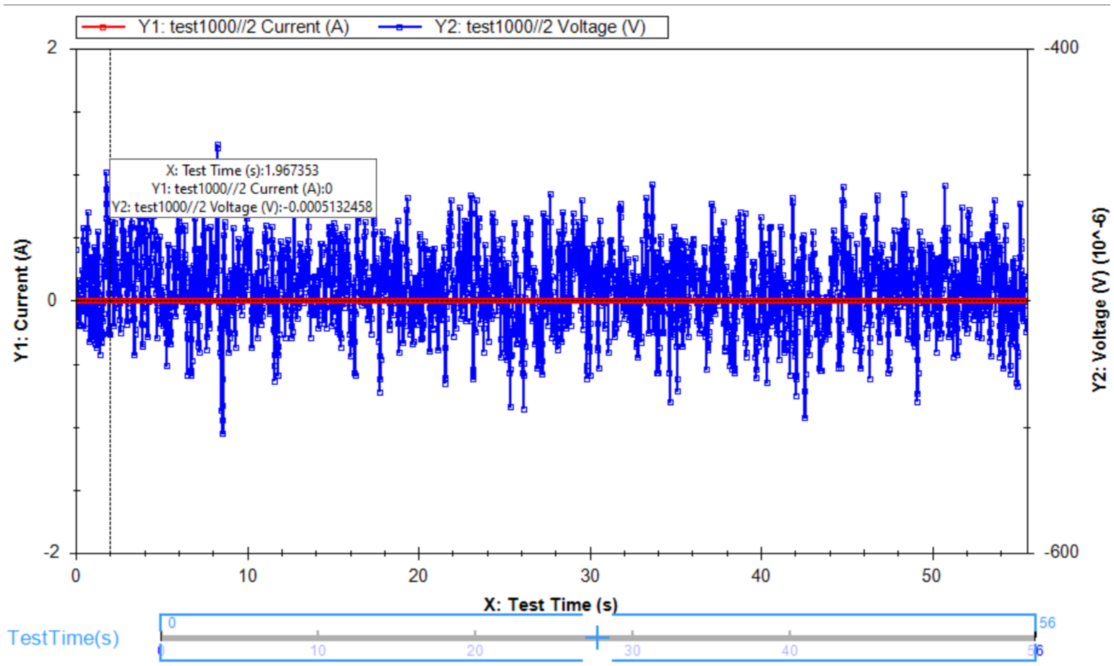


Figure 11-32 Screenshot with Custom Axis Title Font and Scale Style

11.3.2 Use Additional Data Display Features

Use the Arbin Scale Ruler

1) To view the X/Y coordinates of any data point, you can click the Arbin Ruler icon in the top menu bar, as shown in Figure 11-33.

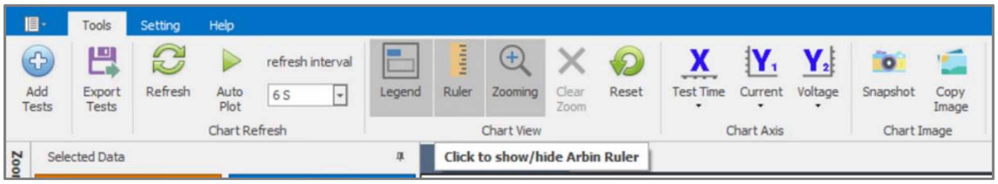


Figure 11-33 Select the Arbin Ruler by Clicking the Ruler Icon in the Top Menu of the Toolbar

2) Move the cursor to the drawing area and right-click on a point to view the values of all intersection points between the axis and the graph will be displayed, including the value of the point, test time, number of cycles, number of steps, and more.

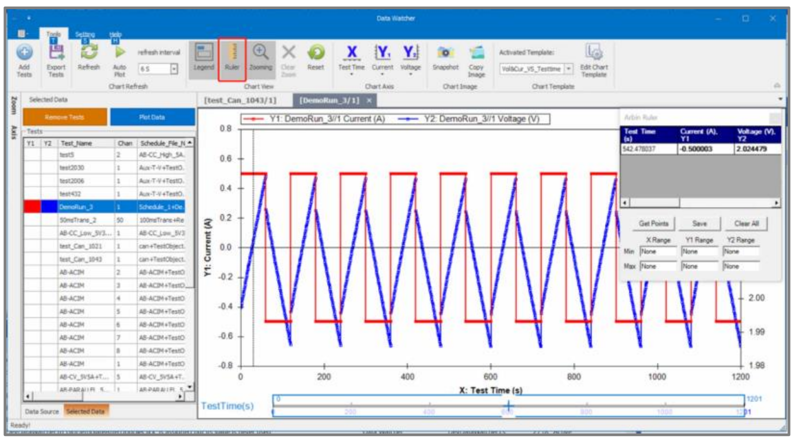


Figure 11-34 Right Click to Display the Value of a Certain Point

Use Zoom

In the Zoom tab of the DataWatcher sidebar (Figure 11-35), the user can manually change the axis range by setting the minimum and maximum values of each axis.

Figure 11-35 Zoom Set Up

Use the Tools Tab

The icon button list on the top toolbar menu provides users with the flexibility to use DataWatcher. The Tools tab contains the most used buttons for interacting with the chart. The chart buttons are divided into “Chart Refresh,” “Chart View,” “Chart Axis,” “Chart Image,” and “Chart Template” categories.

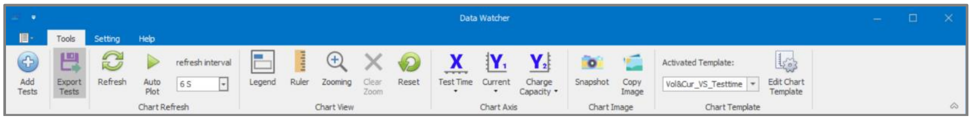


Figure 11-36 The DataWatcher Tools Tab

11.3.3 Use Chart Refresh

Refresh the Plotting Manually

1) Click the “Refresh” button  on the DataWatcher Toolbar to immediately refresh the newly collected data points.
2) This operation causes the graph to be refreshed only once, and the button needs to be clicked again to obtain updated data points.

Refresh the Plotting Automatically

1) Click the “Auto Plot” button  on the DataWatcher Toolbar to refresh the plot as soon as new data points are acquired.
2) There will be a small interval of time for the plot to refresh again within the selected time interval automatically.

After clicking the “Auto Plot” button which displays as  when active, most buttons will be disabled, such as most button icons on the top toolbar, the Remove Tests and Plot Data buttons. The “Stop” button icon will be displayed, and you can stop the Auto Plot/refresh operation by clicking the “Stop” button.

11.3.4 Use Display Options in Chart View

Use Zoom

1) Click the “Zoom” button on the DataWatcher Toolbar.
2) Use the cursor to select an area of the chart to have DataWatcher zoom in on the chart in the selected area.
3) Move the cursor within the drawing area and scroll the mouse wheel up or down to zoom in or zoom out in the chart area.
4) The “Clear Zoom” button in the DataWatcher Toolbar is used to remove all zoom operations and return the chart view to the original zoom level.

Show/Hide the Legend

The button  on the top menu bar toggles the chart legend between showing and hiding.

Reset a Chart

The Reset button icon  on the top toolbar restores the chart to the original chart. The chart returns to the initial X, Y1, and Y2 and their full range.

11.3.5 Save Chart Images

Save a Chart as a PNG Image File

1) Click the “Snapshot” icon on the DataWatcher Toolbar.
2) This feature will convert the chart to a PNG image and open a Interface to save the chart graphic.

Copy a Chart to the Clipboard

1) Click the “Copy Image” icon on the DataWatcher Toolbar.
2) This copies the currently displayed chart in the current tab page as an image to the Interfaces clipboard.
3) You can paste the copied image into Word, email, and other documents through the Interfaces clipboard.
4) To change the width and height of the image, go to the “Setting” tab on the top toolbar and click the “More Settings” icon.

11.3.6 Use the Viewfinder

Adjust the Range of a Frame

1) On the X/Y axis, move the axis or move the cursor to the viewfinder frame to adjust the range of the moving Interface to view a part of the curve. For example, Figure 11-37 shows all Test Time graphs.
2) Select a range by dragging or moving the moving Interface.

EXAMPLE: Figure 11-38 shows a chart of Test Time from 0 to 601 seconds. Click TestTime(s) on the left side of the view frame to change it to the CycleIndex view frame, as shown in Figure 11-39. Once clicked again, the viewfinder frame will change back to Test Time(s), as shown in Figure 11-37.

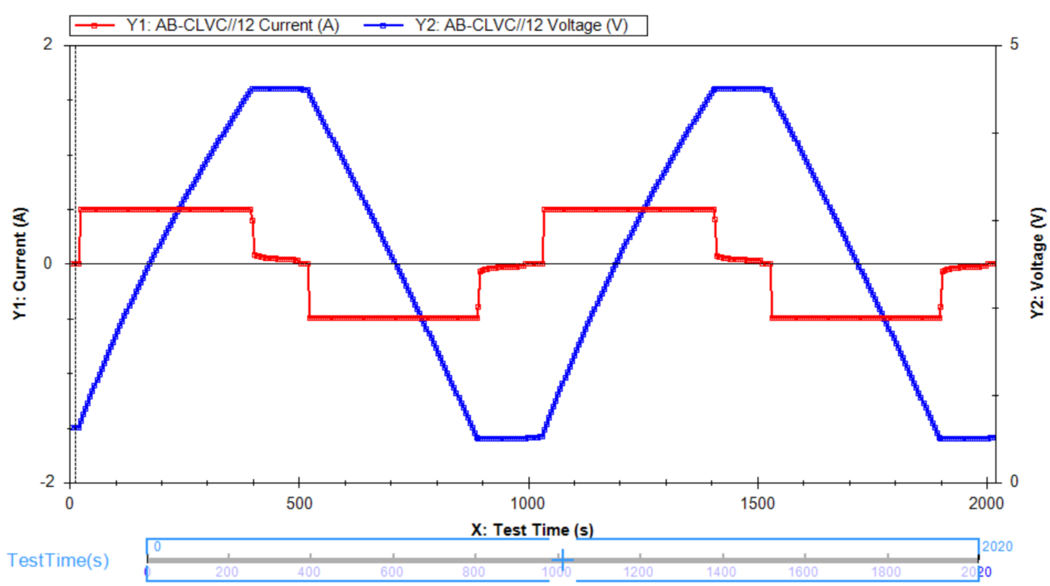


Figure 11-37 The Viewfinder is Test Time(s)

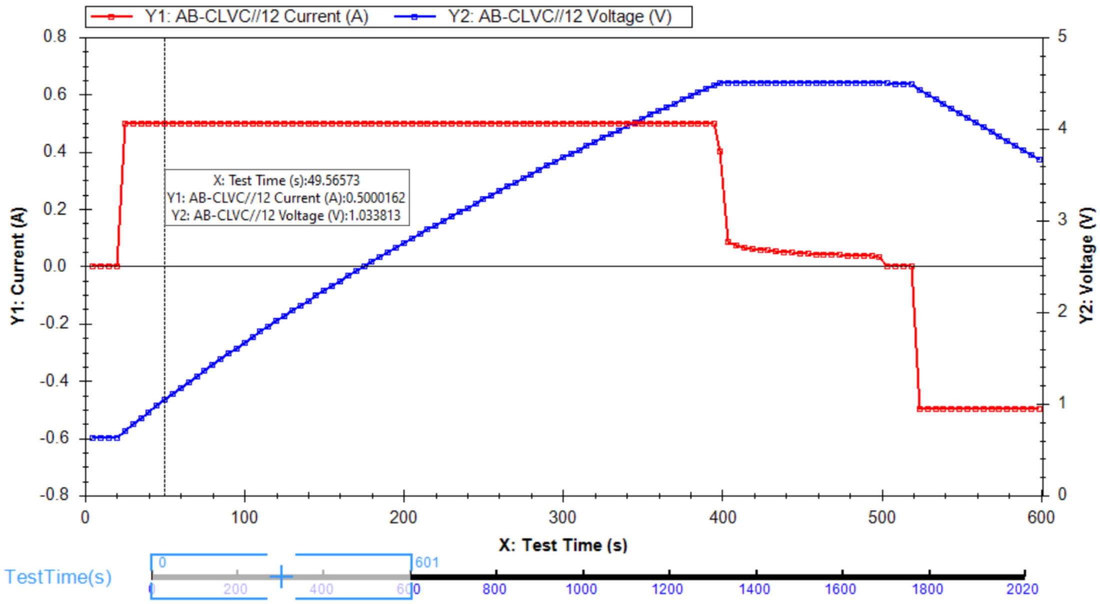


Figure 11-38 Test Time(s) From 0 to 601

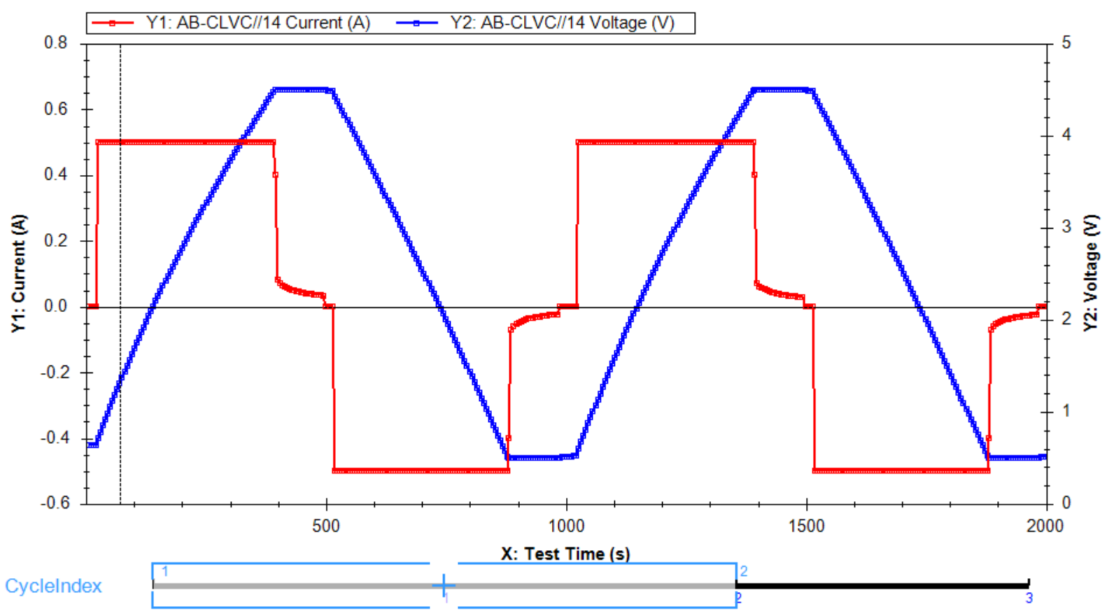


Figure 11-39 The Viewfinder is CycleIndex

Viewfinder Right-Click Menu Options

Use the right-click menu of the Viewfinder to access options including Reset Range, Customize Plot Range, Test Time <-> CycleIndex, and Set Time Scale (described below).

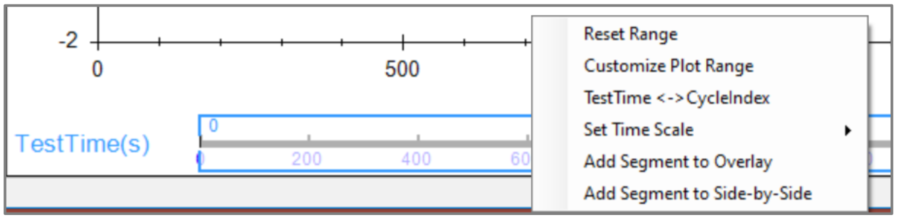


Figure 11-40 Right Click the Viewfinder to Bring Up Its Drop-Down Menu

Reset the Range of a Frame

Reset the moving Interface of the viewfinder from 0 to the end and update the chart.

Customize the Plot Range

Accurately select the Test Time or Cycle Range of the test data to be observed.

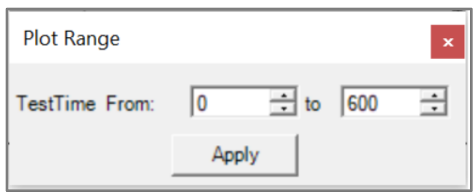


Figure 11-41 Test Time Range Setting

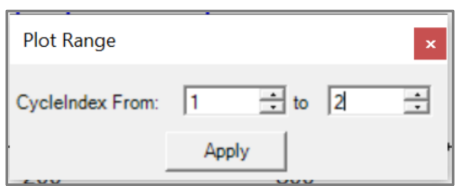


Figure 11-42 Cycle Range Setting

Switch Between Test Time and Cycle Index Modes

Switch the frame mode between the Test Time and Cycle Index.

Adjust the Time Scale

If the name of the X-axis is "Test Time", the user can switch the time unit to seconds, minutes, hours, or days in Set Time Scale.

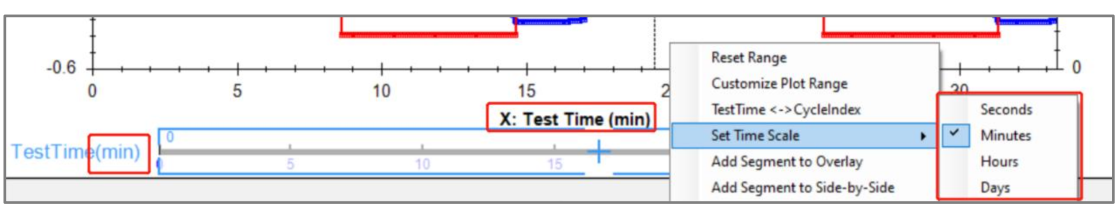


Figure 11-43 Set Time Scale

Use Zoom Via the Mouse Wheel

Use the mouse wheel to zoom in or out. DataWatcher will redraw when zooming in or out, and the viewfinder will also change.

11.3.7 Display Data on the Curve

Display Data on the Curve

1) Move the cursor precisely to the X-axis of the curve, and a data frame will appear showing the value of this data point.
2) Click the "More Setting" icon in the Setting tab on the DataWatcher Toolbar to use this function.
3) In the More Setting Interface that pops up, check the Auto Display check box to enable this function.

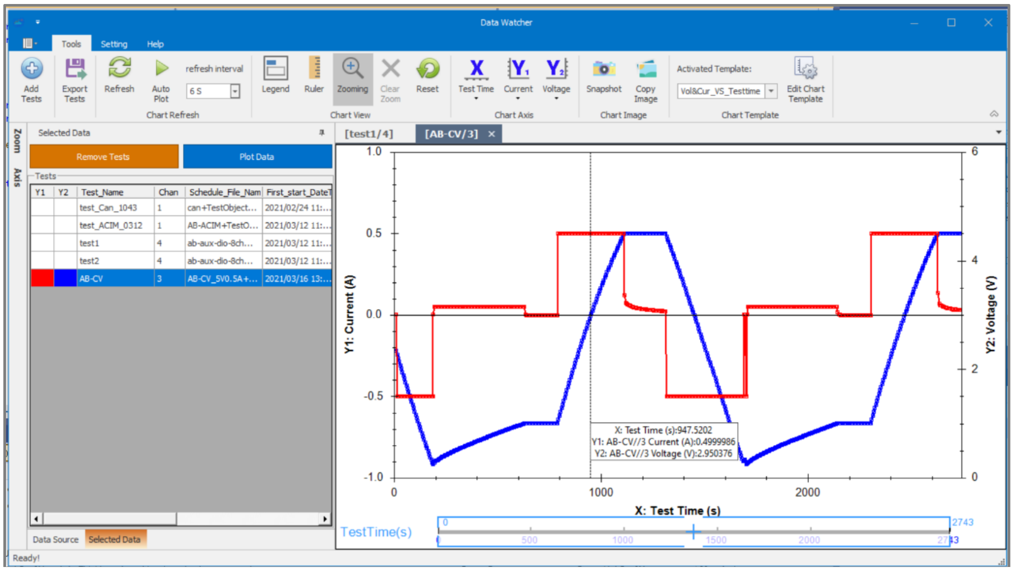


Figure 11-44 Represent Data at the Curve Point in DataWatcher

Display the Entire Data of a Curve

1) Move the cursor to any label on the legend.
2) Left-click on the label and a Interface containing the data representing the curve will appear.

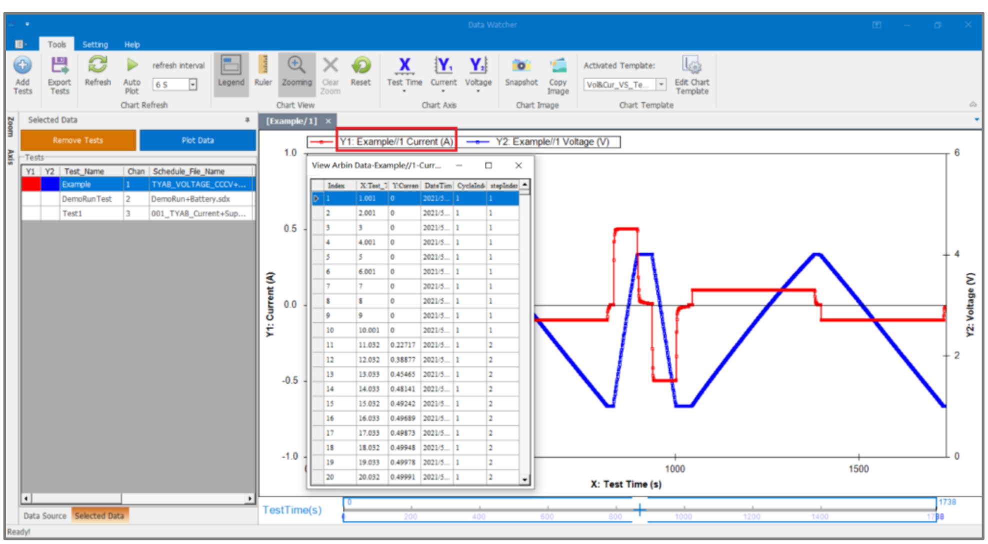


Figure 11-45 View the Data of the Entire Curve in DataWatcher

Import Mits X Data into DataWatcher

1) During the test, select one or more channels.
2) Click the “DataWatcher” icon in the Monitor toolbar to automatically import the result data to DataWatcher. This function provides a real-time view of test result data.

EXAMPLE: Start to run the test process 001_TYAB_Current+SuperCapacity_2.7V_25F.sdx, and give the test name “Test1”. Select channel 3, and then click the DataWatcher icon in the Monitor toolbar. The “Test1” data will be automatically loaded and plotted.

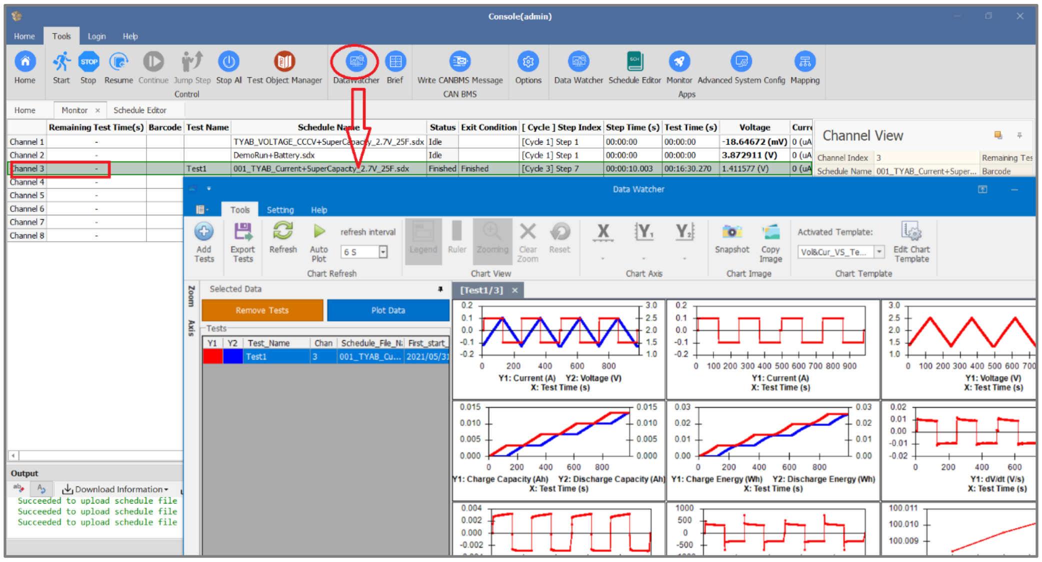


Figure 1-46 Automatically Import Tests to DataWatcher and Draw Test Charts

12: The System Configuration File

12.1 Introduction to the System Configuration File

12.1.1 What is the System Configuration File?

The System Configuration File is used to configure the functions supported by your Arbin battery test equipment. The System Configuration File is configured by the Arbin team before your system leaves the factory and, with few exceptions, you generally will not need to make modifications to this file.

NOTE: Any modifications to the System Configuration File will have a serious impact on the functionality of the Arbin test system. Therefore, in addition to hardware calibration, you are advised to contact Arbin Customer Support before making any changes. Even so, we recommend that you also back up the existing ArbinSys.cfg file before making changes. As an additional backup, Arbin Customer Support keeps a copy of the original installation that can be used in case the System Configuration File is accidentally damaged.

The System Configuration File of Arbin is divided into two parts: Advanced System Config and Config.

12.2 Manage Advanced Functions with Advanced System Config

Advanced System Config is used to configure the advanced functions and control types supported by the machine.

12.2.1 Open the Advanced System Config Interface

Open the Advanced System Config Interface in one of two ways:

1) Double-click the "Advanced System Config" icon on the Console home page.
2) Double-click the "Advanced System Config" icon on the WinDaq Toolbar.

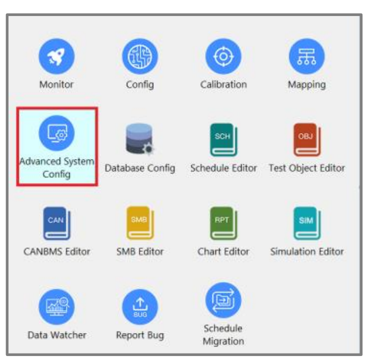


Figure 12-1 The Advanced System Config Icon on the Console Home Page

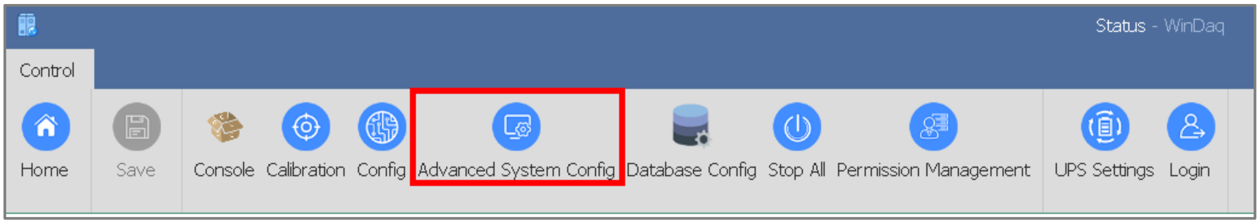


Figure 12-2 The Advanced System Config Ion in the Control Toolbar

12.2.2 Selections in Advanced System Config

Mits X provides four different selections:

1) Customized (Figure 12-4)
2) LBT21 Series (Figure 12-5)
3) LBT22 Series (Figure 12-6)
4) PWM Series (Figure 12-7)

You can alternate viewing the Advanced Feature and Control Type settings of each device type by clicking on the respective tabs to the left of the Advanced System Config interface.

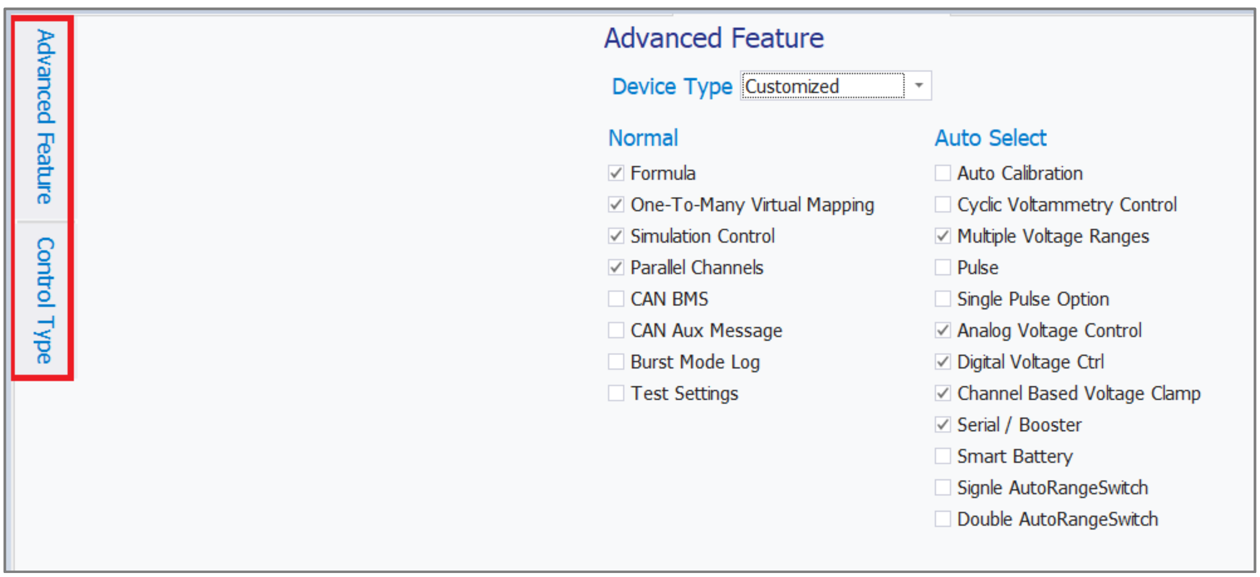


Figure 12-3 Click the Tab to View Advanced Feature and Control Type Settings

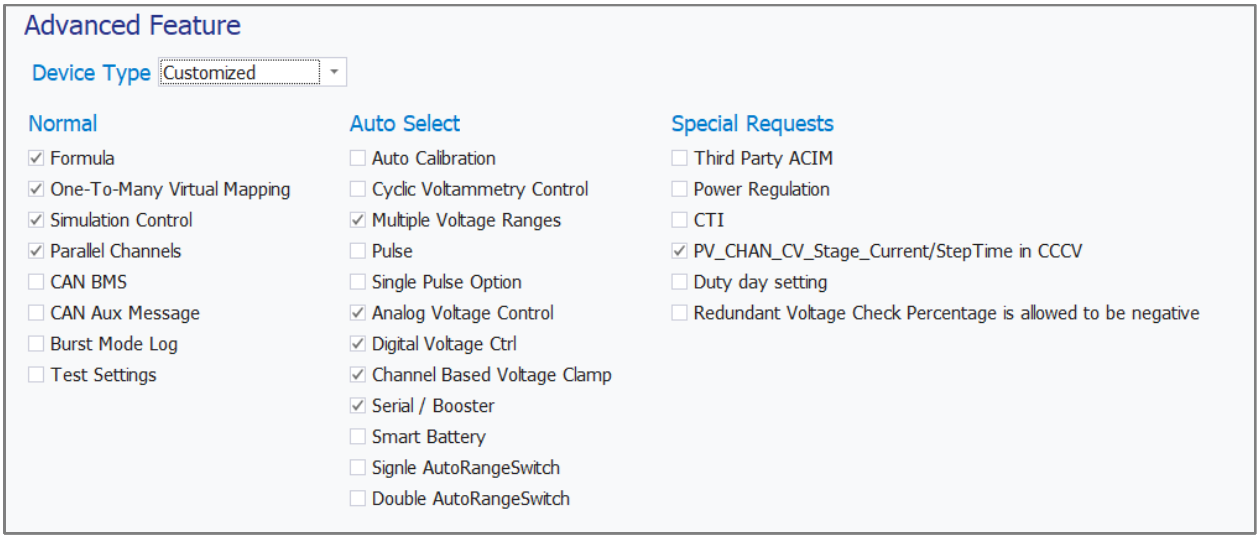


Figure 12-4 Customized Advanced Feature Settings

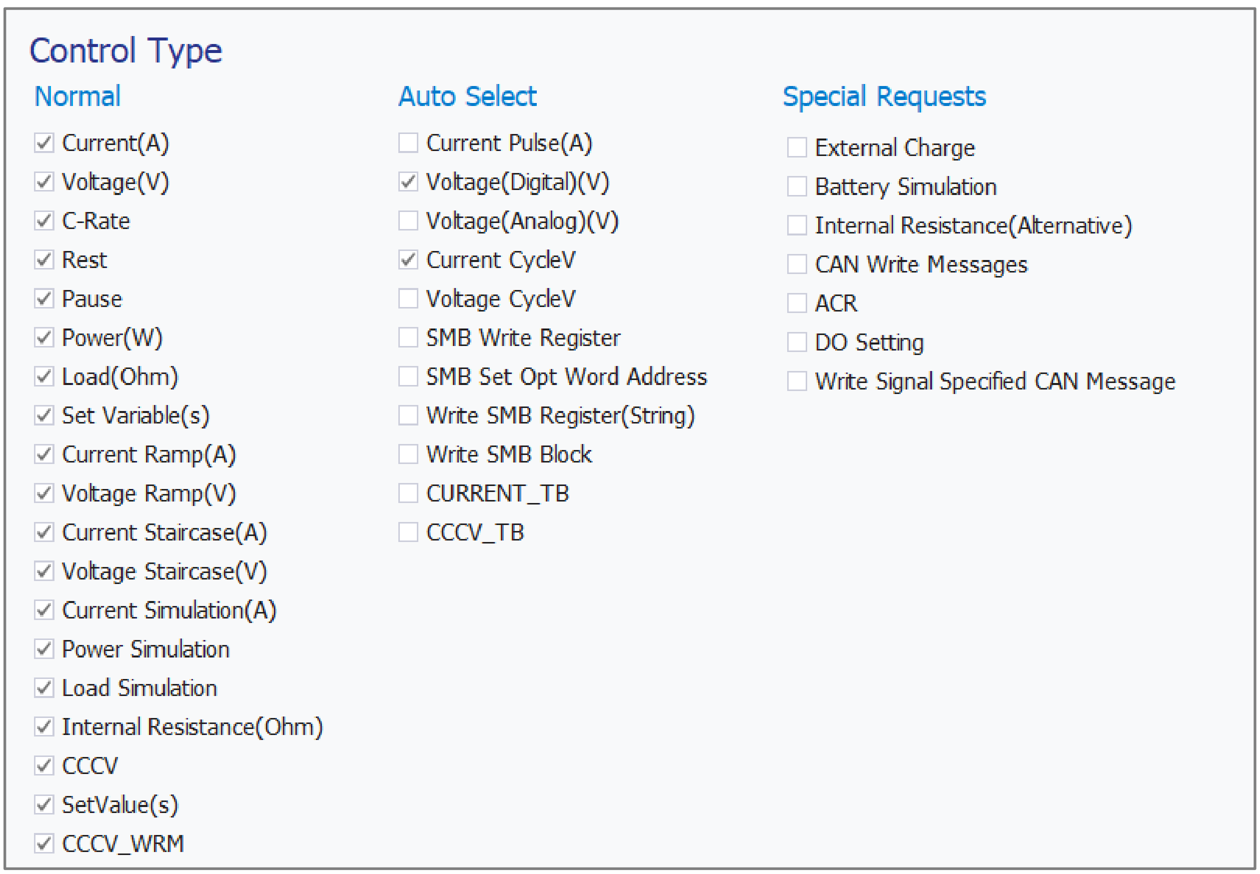


Figure 12-5 Customized Control Type Settings

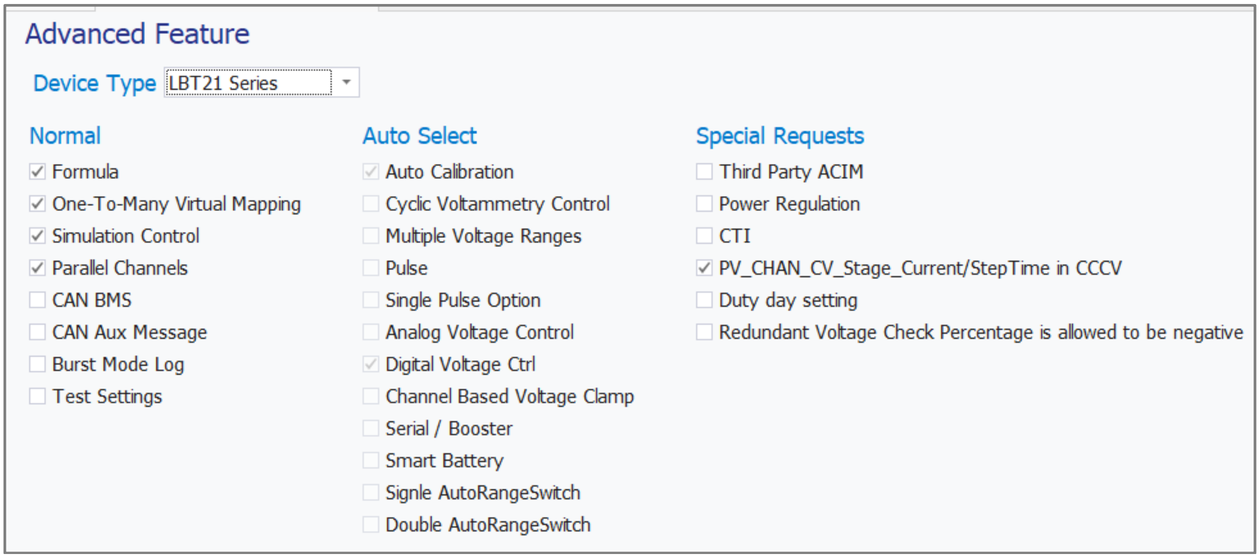


Figure 12-6 LBT21 Series Advanced Feature Settings

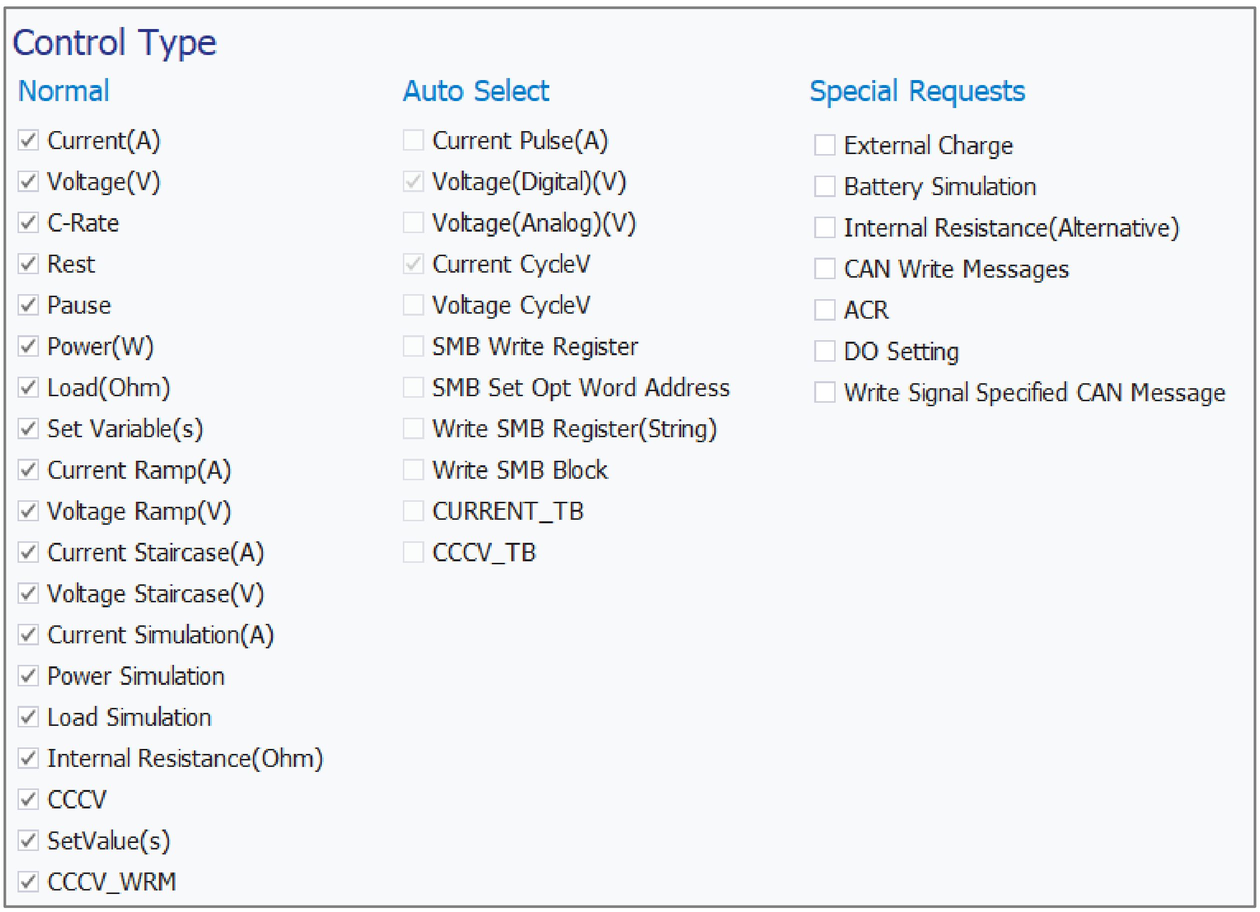


Figure 12-7 LBT21 Series Control Type Settings

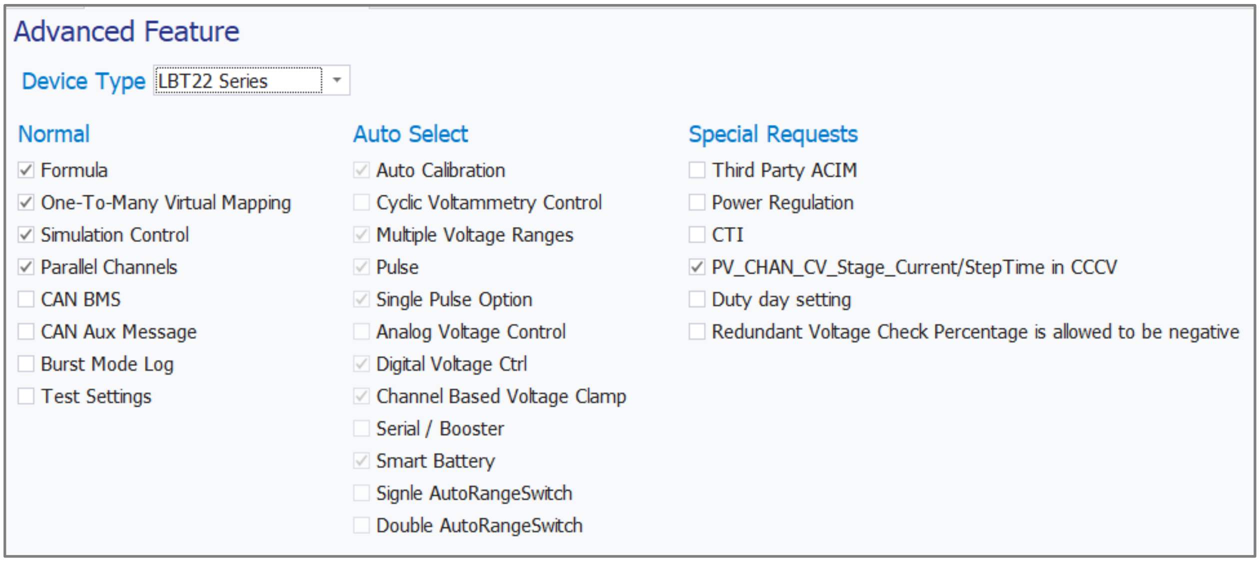


Figure 12-8 LBT22 Series Advanced Feature Settings

Figure 12-9 LBT22 Series Control Type Settings

Figure 12-10 PWM Series Advanced Feature Settings

Figure 12-11 PWM Series Control Type Settings

12.2 Configure the Hardware Channel and Auxiliary with Config

Config is mainly to configure the hardware channel and auxiliary of the device.

Open the Config Interface in one of two ways:

1) Double-click the "Config" icon on the Console home page.
2) Double-click the "Advanced System Config" icon on the WinDaq Toolbar.

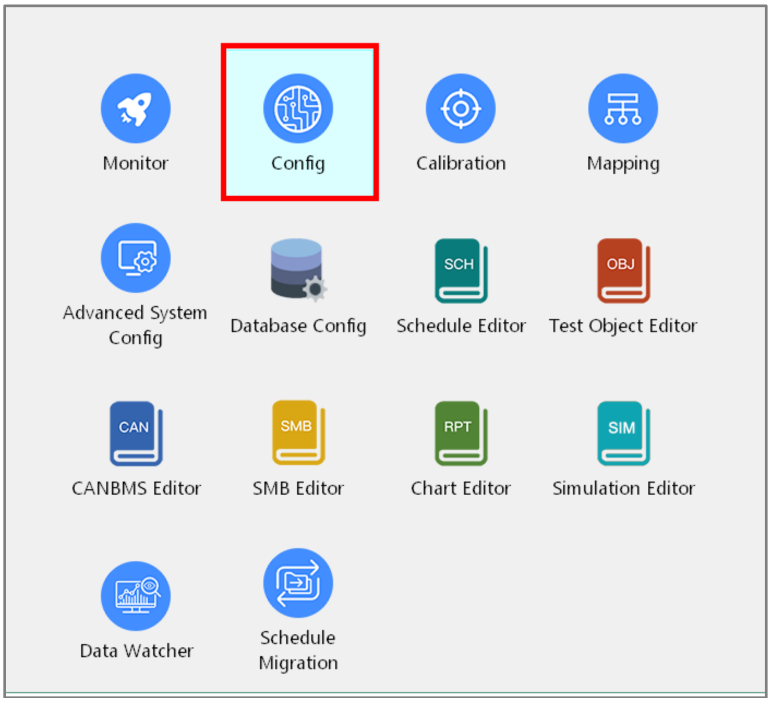


Figure 12-12 Config Icon in the Console Home Page

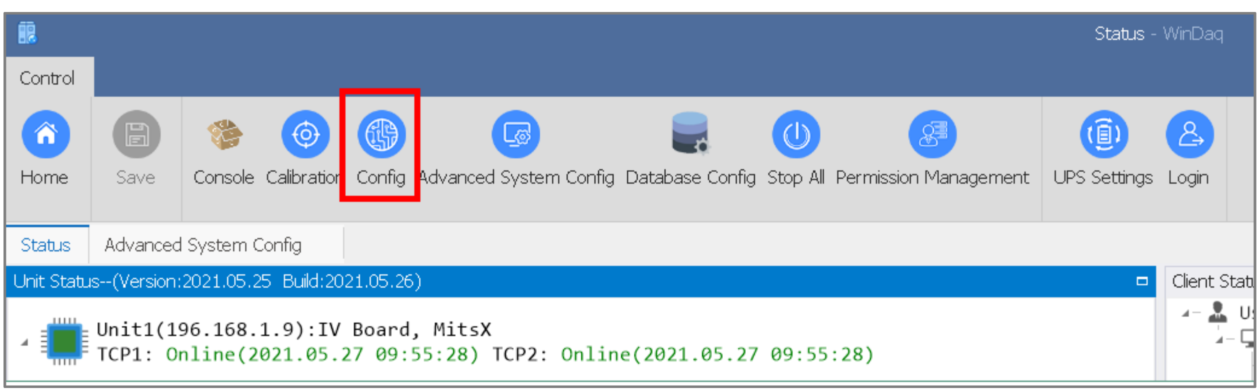


Figure 12-13 Open Config from the WinDaq Toolbar

Config is the editable interface of the System Configuration File, ArbinSys.cfg.

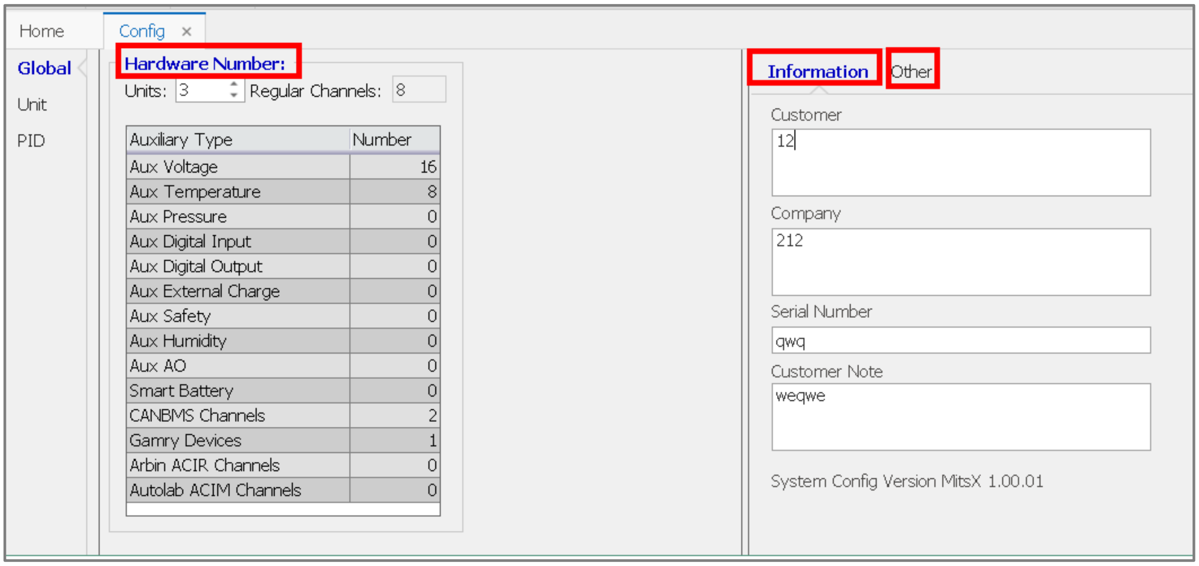


Figure 12-14 The Config Interface

12.2.1 View Global Page Settings

The Global page contains three parts: Hardware Number, Information, and Other, as shown in Figure 12-14 above. The following sections introduce the specific functions of the three parts.

Hardware Number

In the Hardware Number section, on the Units can be edited. The other elements show the number and types of primary IV and auxiliary channels installed in the Arbin test bench.

NOTE: You should never modify these parameters unless a new hardware module is added.

Information

This section includes information about the customer, including customer name, company, and customer notes.

Other

This section is used for the configuration of additional parameters of the Arbin test software, as shown in Figure 12-15.

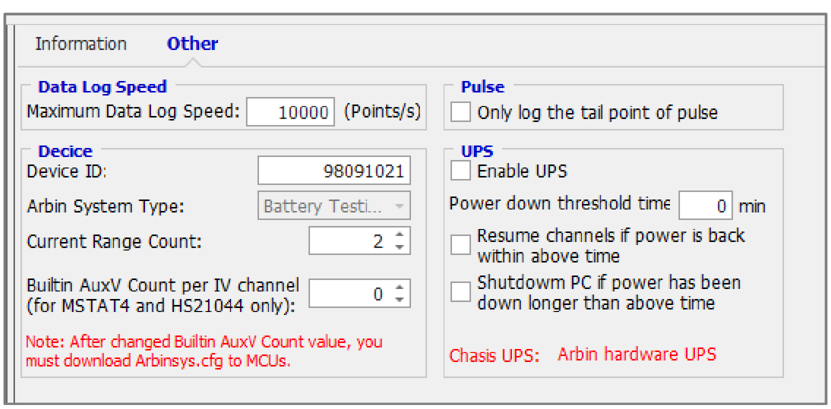


Figure 12-15 Configure Additional Parameters of the Arbin Test Bench

Other Tab field descriptions:

1) **Data Log Speed** – Configure the maximum log rate. If the log rate of all channels exceeds this configuration, the channel with the highest log rate will stop automatically.
2) **Pulse** – Configure Pulse and determine whether to record only the endpoint of the pulse.
3) **Device** – Configure the device ID of the Arbin test software, the number of current ranges, and several built-In auxiliary voltages for each IV channel.
4) **UPS** – In a system with a UPS, these settings are used to determine how the system responds to power interruptions. Power down threshold time, Resume channels, Shutdown PC configuration are used to customize the selection bar and parameters of the interface. However, Arbin strongly recommends keeping the default settings for the first three fields as they are most suitable for Arbin's major UPS suppliers.

12.2.2 View Unit Page Settings

Device-Computer Connection Settings

The Unit interface is divided into two parts. The settings in the upper part can identify the connection between the device and the computer and the hardware structure. Likewise, users should never change these values unless specifically instructed by an Arbin customer service representative. The parameters of the IV channel or various auxiliary channels can be configured in the next part, as shown in Figure 12-16.

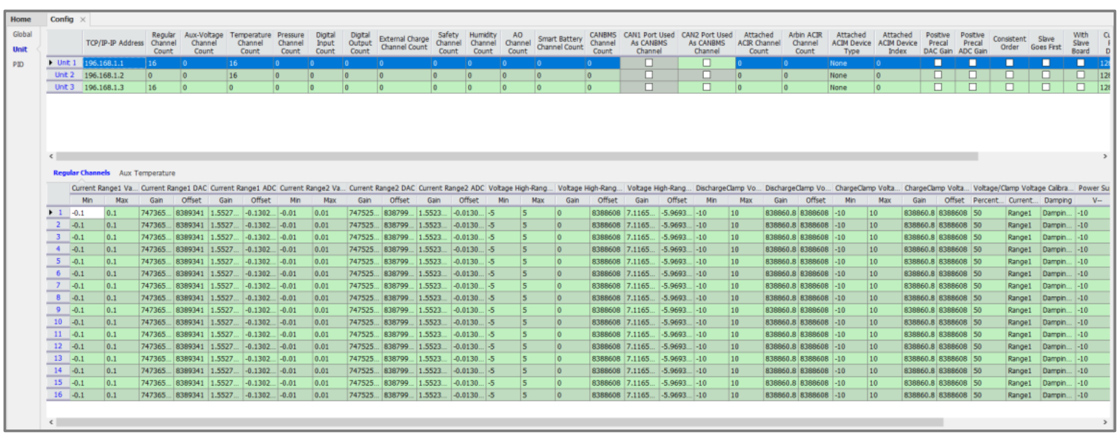


Figure 12-16 Unit Page

Regular Channels

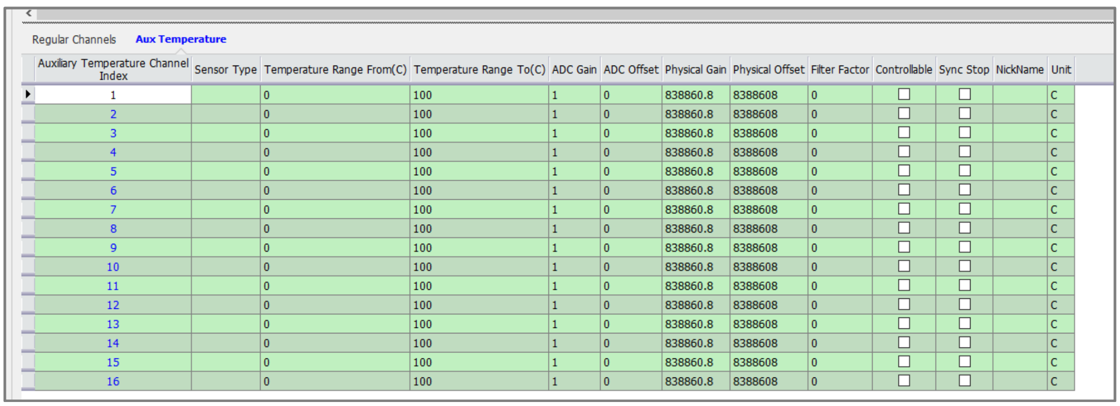
The remaining pages in ArbinSys.cfg store the calibration data of the DAC and ADC of the channel. These values are set before shipment from the Arbin factory, and users usually can only modify certain constants through calibration. Some exceptions are the Nickname field of all auxiliary channels (such as the example below) and certain explicitly designated auxiliary channels, such as controllable temperature and flow.

In addition, you can set global security limits for the instrument in the last four columns of the "Channel" page. These restrictions take precedence over any parameters entered on the Global page in the schedule file. You can disable upper and lower limits by typing “0” in the field. However, if only one of the limits is “0,” both limits will operate normally.

EXAMPLE: You can set “0” at the lower limit of “Current Safety,” and set a positive value at the upper limit of “Current Safety.” Even during the calibration process, these two current safety upper and lower limits are still valid.

Auxiliary Temperature

As mentioned above, most column contents can only be edited by calibration. However, the control temperature can be independently input to the adjustment parameters when using a third-party temperature control chamber. By checking the “ArbinSys.cfg” option, the user can set the temperature of the temperature control chamber by assigning the channel in the “Mapping” and creating “TestSetting” (Set by the ListenForNet app).



Auxiliary Temperature Channel Index	Sensor Type	Temperature Range From(C)	Temperature Range To(C)	ADC Gain	ADC Offset	Physical Gain	Physical Offset	Filter Factor	Controllable	Sync Stop	NickName	Unit
1		0	100	1	0	838860.8	8388608	0	☐	☐		C
2		0	100	1	0	838860.8	8388608	0	☐	☐		C
3		0	100	1	0	838860.8	8388608	0	☐	☐		C
4		0	100	1	0	838860.8	8388608	0	☐	☐		C
5		0	100	1	0	838860.8	8388608	0	☐	☐		C
6		0	100	1	0	838860.8	8388608	0	☐	☐		C
7		0	100	1	0	838860.8	8388608	0	☐	☐		C
8		0	100	1	0	838860.8	8388608	0	☐	☐		C
9		0	100	1	0	838860.8	8388608	0	☐	☐		C
10		0	100	1	0	838860.8	8388608	0	☐	☐		C
11		0	100	1	0	838860.8	8388608	0	☐	☐		C
12		0	100	1	0	838860.8	8388608	0	☐	☐		C
13		0	100	1	0	838860.8	8388608	0	☐	☐		C
14		0	100	1	0	838860.8	8388608	0	☐	☐		C
15		0	100	1	0	838860.8	8388608	0	☐	☐		C
16		0	100	1	0	838860.8	8388608	0	☐	☐		C

Figure 12-17 Aux Temperature

Thermocouple Conversion Formula

For thermocouple input, the setting of the conversion formula is the default, as shown in the figure below, such as E, J, K, or T thermocouple. This is set by ListenForNet.

Thermal Resistance Conversion Formula

For thermistor input, the setting of the conversion formula depends on the nominal resistance. The “default” formula applies to thermistors with a nominal resistance of 10kΩ. (This is set by ListenForNet.)

For the thermistors with other resistance values, please call Arbin Customer Support and ask how to select the appropriate conversion formula in the drop-down menu. For example, choose PT100 as the 100-ohm resistance conversion formula.

1) **Auxiliary pressure** – The auxiliary pressure channel behaves similarly to the auxiliary temperature channel. This is set by ListenForNet.
2) **Auxiliary voltage** – The auxiliary voltage channel behaves similarly to the auxiliary temperature channel. This is set by ListenForNet.
3) **DI/DO** – The auxiliary digital input/output channel behaves similarly to the auxiliary temperature channel. This is set by ListenForNet.
4) **External Charge** – The auxiliary External Charge channel behaves similarly to the auxiliary temperature channel. This is set by ListenForNet.

5) **Humidity** – The behavior of the auxiliary Humidity channel is similar to that of the auxiliary temperature channel. This is set by ListenForNet.
6) **Aux Ao** – The auxiliary analog output channel behaves similarly to the auxiliary temperature channel. This is set by ListenForNet.

12.2.3 Managing PID Page Settings

The PID page is used to configure the PID parameters of each channel.

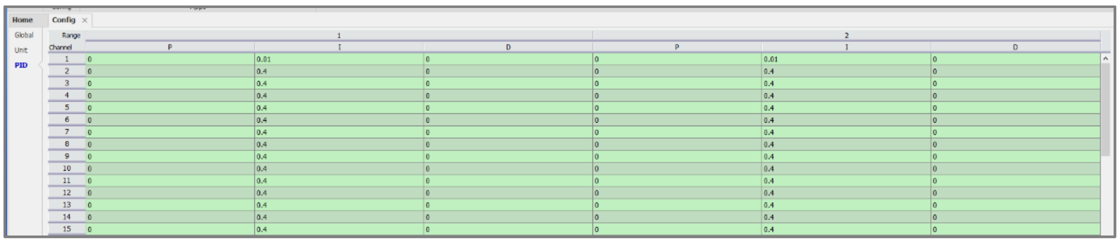


Figure 12-18 PID Page

13: CAN BMS

13.1 Introduction to CAN BMS

13.1.1 What is CAN BMS?

The Arbin battery test system provides CAN-Bus communication for most EVTS systems and high-voltage battery test systems, which will be used for BMS test battery packs. Arbin Mits X software allows you to program your Arbin test equipment to receive and transmit CAN BMS messages from your CAN BMS equipment. This process does not require the use of third-party equipment, DLL software packages, or third-party licenses.

13.1.2 The CAN BMS Editor

Open the CAN BMS Editor

1) Click on the "CAN BMS Editor" icon 

on the Console home page to preview the existing CAN BMS Configuration File. (This is a preview only.)
2) Double-click on the "CAN BMS Editor" icon on the Console home page to open the CAN BMS Editor directly.

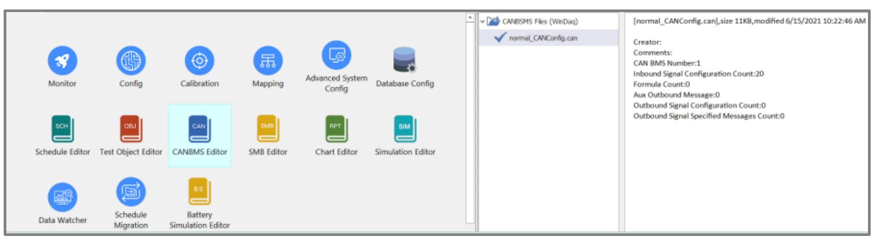


Figure 13-1 Open the CAN BMS Editor

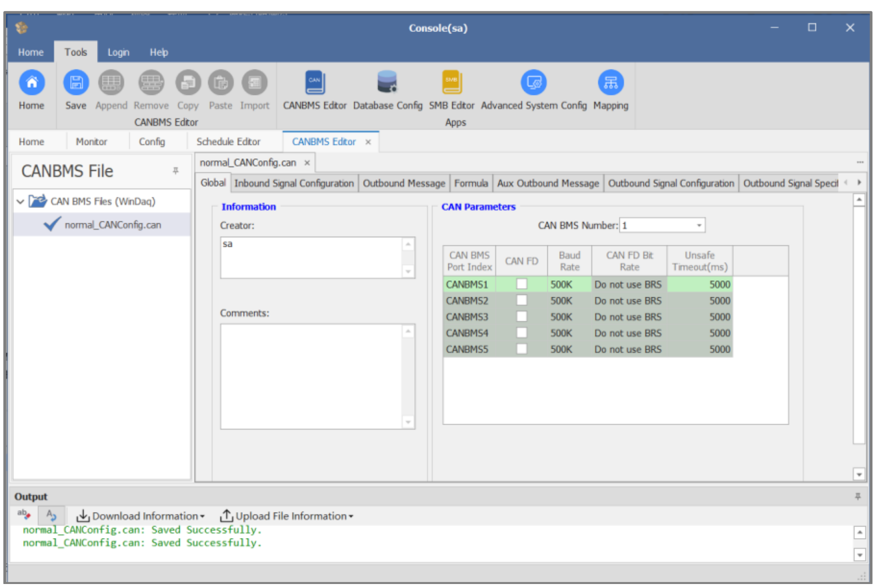


Figure 13-2 The CAN BMS Editor

Open the CAN BMS Editor Locally

1) Right-click on the "CAN BMS Editor" icon on the Console homepage.
2) Click on the "Open this app locally" option that appears to open the local version of the CAN BMS editor and edit the CAN BMS File on the local hard disk.

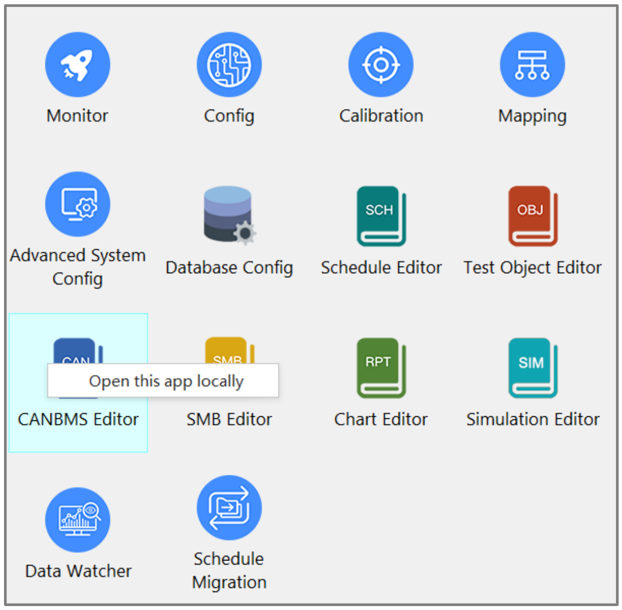


Figure 13-3 Open the CAN BMS Editor Locally

13.1.3 The CAN BMS Toolbar

The CAN BMS Toolbar (Figure 13-4) has several key functions as described below.

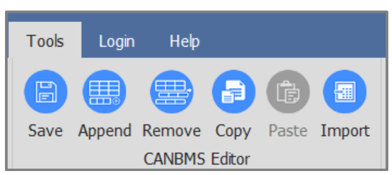


Figure 13-4 The CAN BMS Toolbar

Save a Modified CAN BMS File

1) Make any modifications to the CAN BMS File. For more information, refer to 13.3 Prepare to Use CAN BMS.
2) Click on the "Save" icon in the CAN BMS Toolbar to save the modified file.

Add a CAN BMS Record

1) Start from one of the following pages of the CAN BMS Editor:
   a) Inbound Signal Configuration Page
   b) Formula Page
   c) Aux Outbound Message Page
   d) Outbound Signal Configuration Page
   e) Outbound Signal Specified Messages Page
2) Click on the "Append" icon in the CAN BMS Toolbar to add a corresponding record.

Delete a CAN BMS Record

1) Start from one of the following pages of the CAN BMS Editor:
   a) Inbound Signal Configuration Page
   b) Formula Page
   c) Aux Outbound Message Page
   d) Outbound Signal Configuration Page
   e) Outbound Signal Specified Messages Page
2) Click to select the row of the record that you want to delete.
3) Click on the "Remove" icon in the CAN BMS Toolbar to delete the selected row.

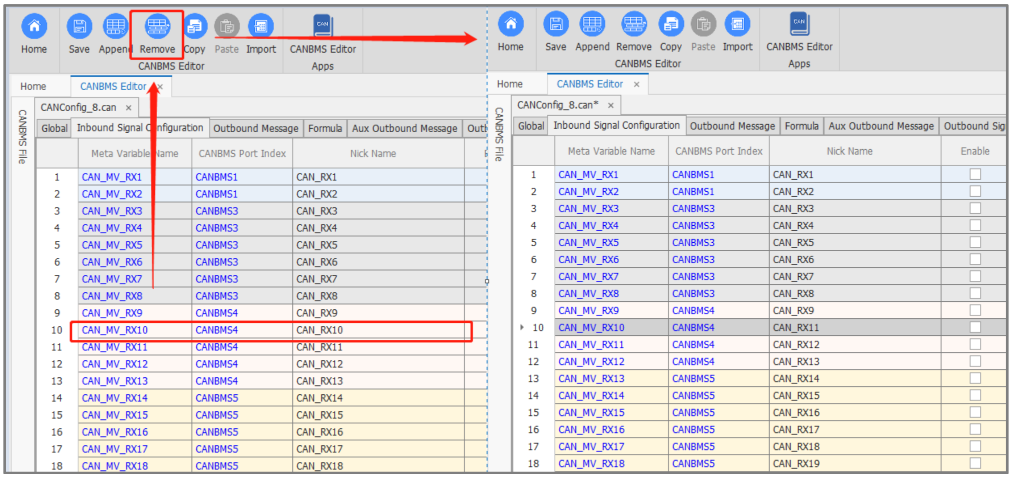


Figure 13-5 Delete a CAN BMS Record

Copy and Paste a CAN BMS Record

1) Start from one of the following pages of the CAN BMS Editor:
   a) Inbound Signal Configuration Page
   b) Formula Page
2) Click to select the row that you want to copy or left-click and drag to select multiple rows.
3) Click on the "Copy" icon in the CAN BMS Toolbar to copy the contents of the selected row(s).
4) Click to select the row to which you want to paste the copied content (or left-click and drag to select multiple rows).
5) Click on the "Paste" icon in the CAN BMS Toolbar to paste the copied content to the selected row.

Import a CAN BMS File

1) Click on the "Import" icon in the CAN BMS Toolbar to open the Import View Interface.
2) Select the file type to be imported, Arbin CAN File for DBC File.
3) Choose the form of import you want to use, Cover or Append.
4) Click the "…" icon on the right of the "Path" input box to open the file selection Interface.
5) Navigate to and select the file you want to import.
6) Click on the "Open" button of the file selection Interface.

7) Click on the “OK” button at the bottom of the Import View Interface to import the selected file.

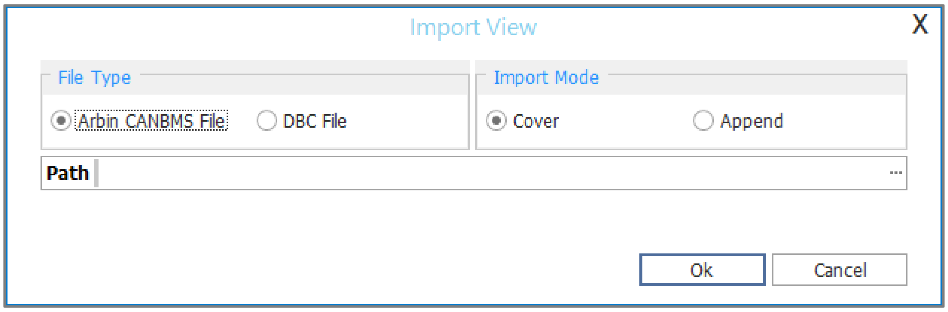


Figure 13-6 Import View Interface

13.2 Manage CAN BMS Files

13.2.1 Create a New CAN BMS File

1) Right-click on the main folder in the CAN BMS File Directory.
2) Click on the “New File” option in the menu that appears to create a new CAN BMS File.

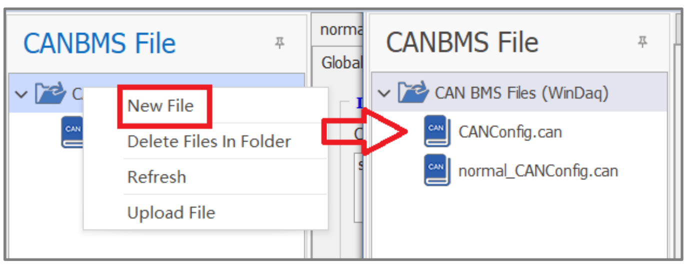


Figure 13-7 Create a New CAN BMS File

13.2.2 Open a CAN BMS File

Open an existing CAN BSM File one of two ways:

1) In the CAN BMS File Directory, click on the CAN BMS File you want to open.
2) In the CAN BMS File Directory, right-click on the CAN BMS File you want to open and click on the “Open” option in the menu that appears to open the file.

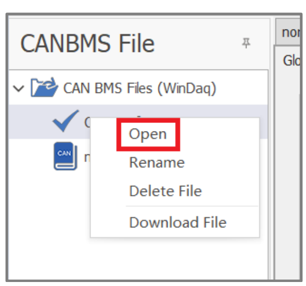


Figure 13-8 Open a CAN BMS File

13.2.3 Upload a CAN BMS File

1) Right-click on the main folder in the CAN BMS File Directory.
2) Click on the "Upload File" option in the menu that appears.
3) In the "Select Files" Interface that appears, navigate to and select the file you want to upload.
4) Click on the "Open" button at the bottom of the "Select Files" Interface to upload the selected file.

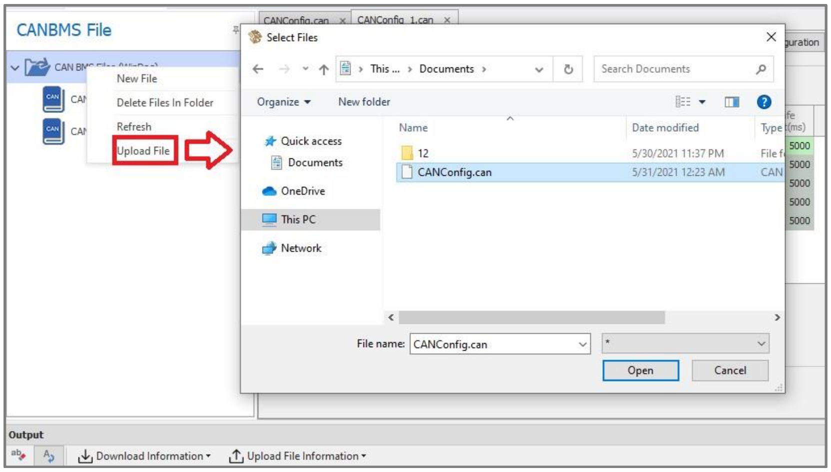


Figure 13-9 Upload a CAN BMS File

13.2.4 Rename a CAN BMS File

1) In the CAN BMS File Directory, right-click on the CAN BMS File you want to rename.
2) Click on the "Rename" option in the menu that appears.
3) Enter the new file name in the "Rename" Interface that appears.
4) Click on the "OK" button in the "Rename" Interface to change the file name.

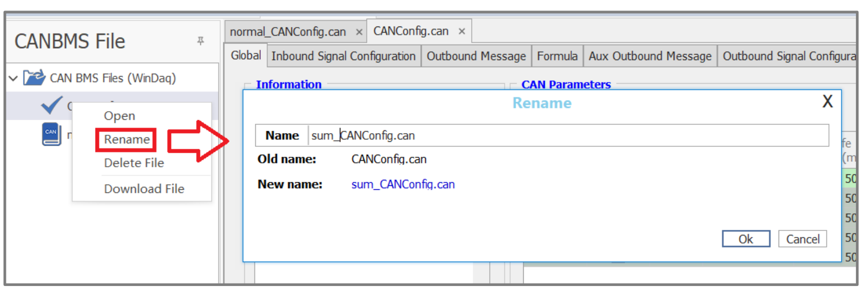


Figure 13-10 Rename a CAN BMS File

13.2.5 Download a CAN BMS File

1) In the CAN BSM File Directory, right-click the CAN BMS File you want to download.
2) Click on the “Download File” option in the menu that appears.
3) In the “Save As” Interface, select the location where you want to save the file.
4) Click on the “Save” button at the bottom of the “Save As” Interface to successfully download the selected file.

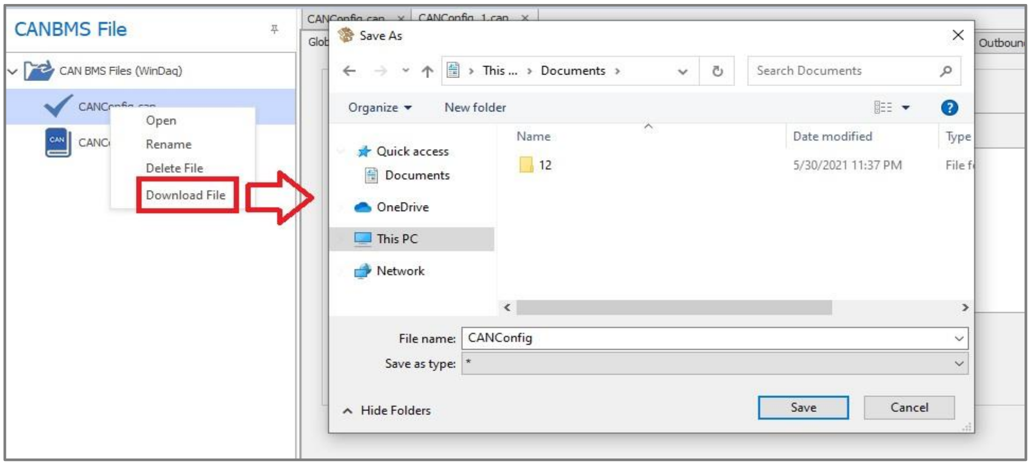


Figure 13-11 Download a CAN BMS File

13.2.6 Delete CAN BMS Files

Delete a CAN BMS File

1) In the CAN BMS File Directory, right-click on the CAN BSM File you want to delete.
2) Click the “OK” button in the pop-up Interface that appears to successfully delete the selected file.

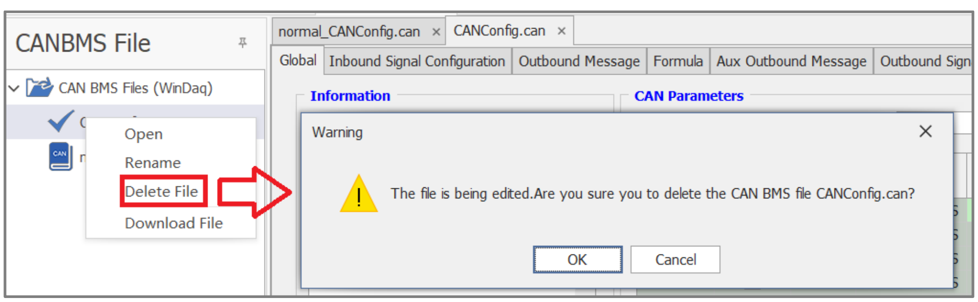


Figure 13-12 Delete a CAN BMS File

Delete All CAN BMS Files in the Directory

1) In the CAN BMS File Directory, right-click on the main directory folder.
2) Click on the “Delete Files in Folder” option in the menu that appears.
3) Click on the “OK” button in the pop-up Interface that appears to delete all the files in the CAN BMS File Directory.

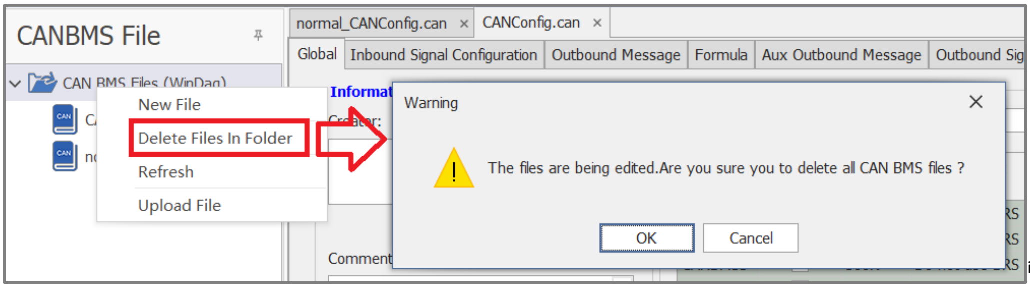


Figure 13-13 Delete all CANBMS Files in the Directory

13.2.7 Refresh the CAN BMS File Directory

1) Right-click on the files in the CAN BMS File Directory.
2) Click on the “Refresh” option in the menu that appears to refresh the CAN BMS File Directory.

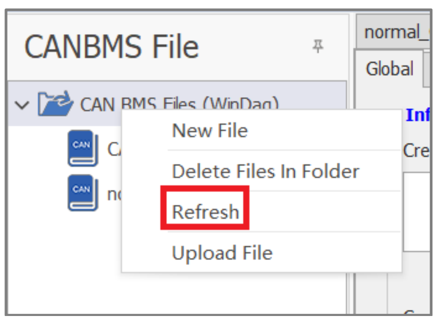


Figure 13-14 Refresh the CAN BMS File Directory

13.3 Prepare to Use CAN BMS

13.3.1 Set Up the System Configuration

Before using the CAN BMS function, system configuration is required.

1) In Advanced System Config, click on the “Advanced Feature” tab to open the Advanced Feature page.
2) In the Normal list, click to check the “CAN BMS” checkmark box.
   a) If you need to use the broadcast CAN BMS auxiliary message function:
      i) Click on the “Control Type” tab to open the Control Type page.
      ii) In the Normal list, click to check the “CAN Aux Message” checkmark box.

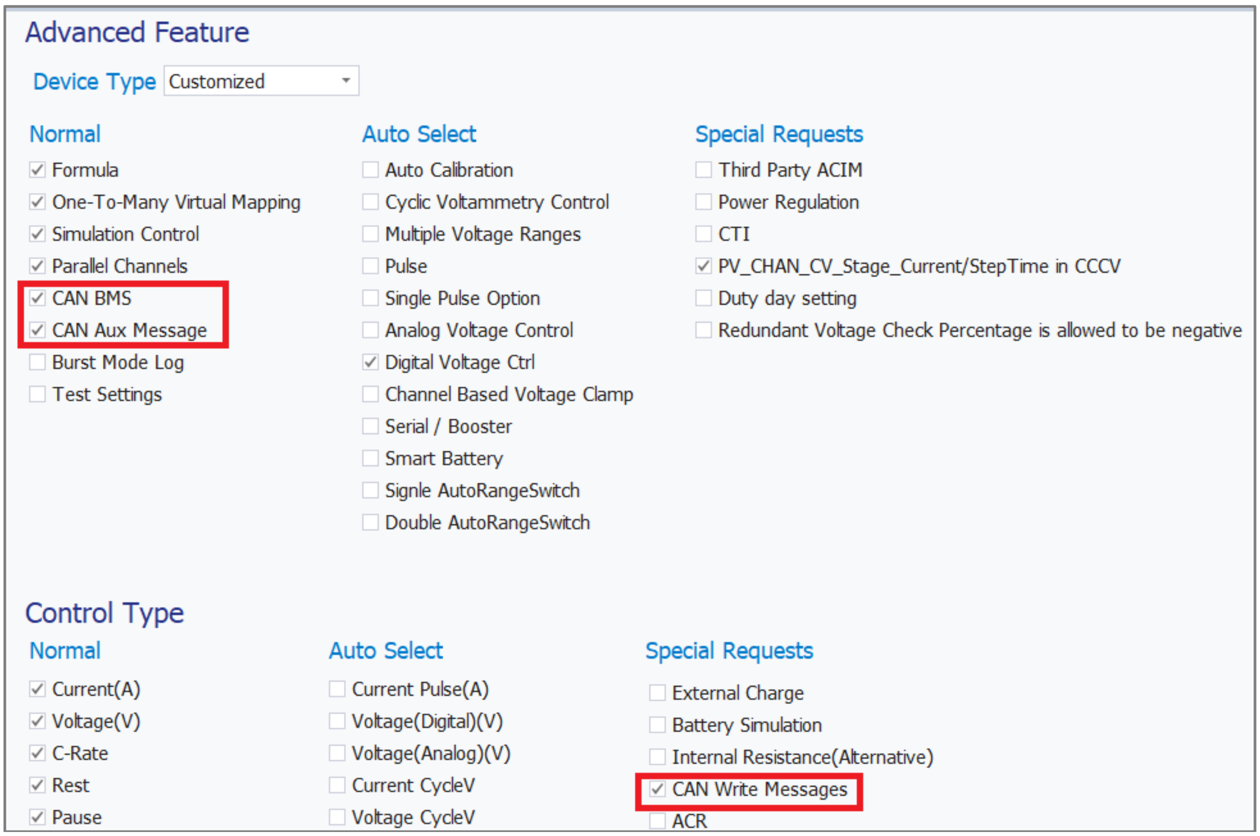


Figure 13-15 CAN BMS System Configuration

13.3.2 Enter the Config Settings

1) Fill in the number of Units on the Global page.

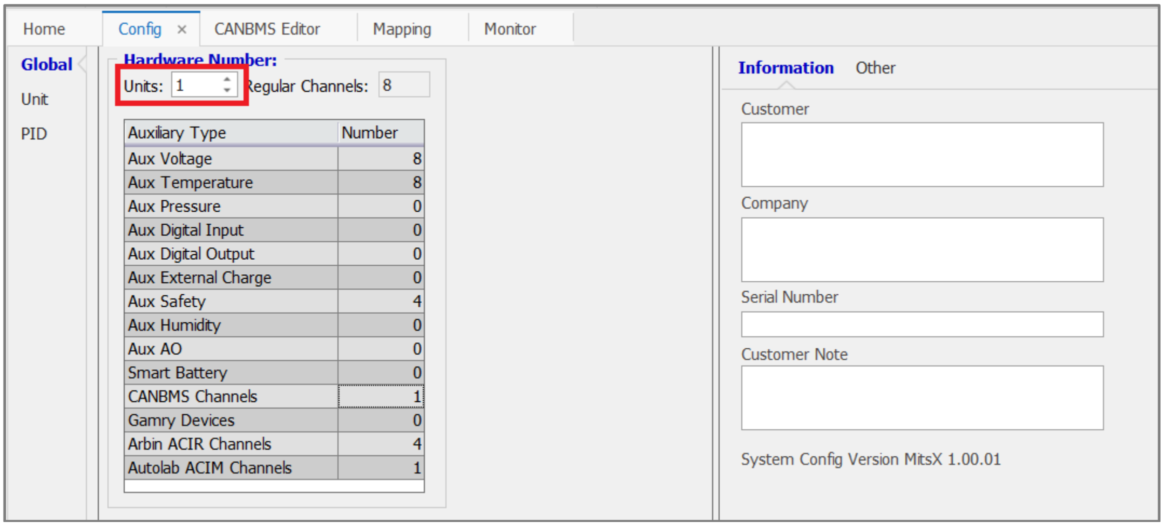


Figure 13-16 Fill in the Number of Units

2) On the Unit page, fill in the IP address of the CAN BMS board, the number of CAN BMS channels, and check the CAN port. Then, click Save and download the System Config to the MCU.

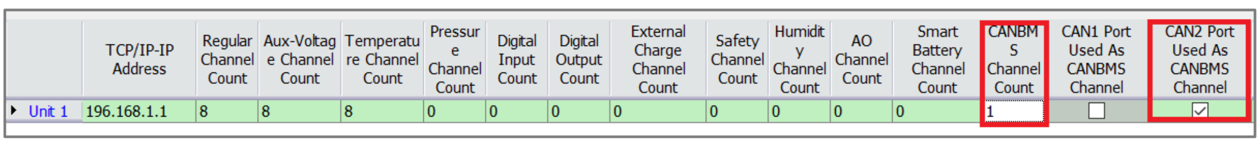


Figure 13-17 Set CANBMS Channel Count in Config

13.3.3 Set up the CAN BMS Mapping

1) On the “Mapping” page, map the CAN BMS channel to the IV channel.
2) Assign a Schedule file with CAN BMS configuration to the corresponding channel to connect to the CAN BMS device.

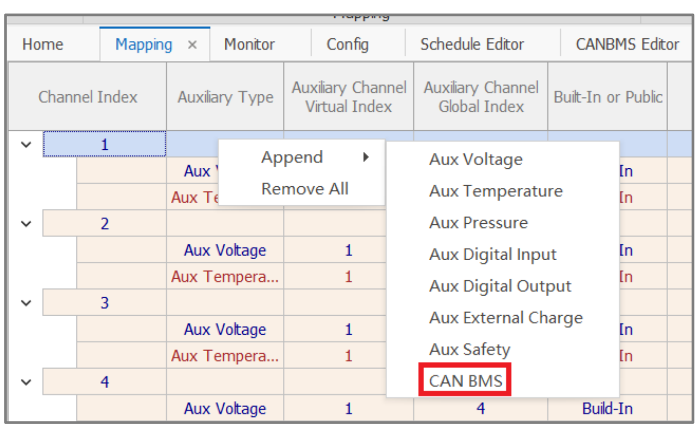


Figure 13-18 Mapping CAN BMS Channel to IV Channel

3) Under the Auxiliary Channel Global Index column, you can switch the CAN BMS port by clicking save to write the mapping information to the MCU.

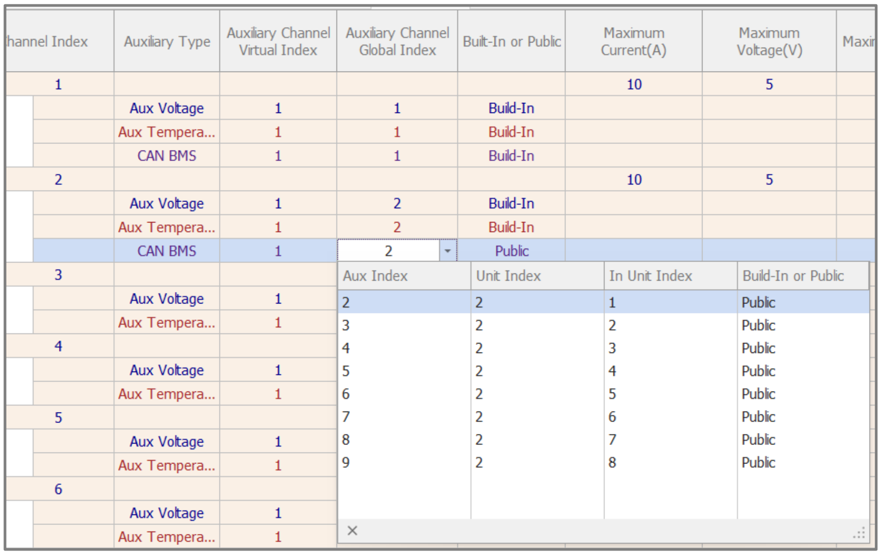


Figure 13-19 Switch CAN Port

Please note that an active CAN BMS must be connected once the channel is assigned a CAN BMS profile. If the system exceeds the Unsafe time set in the CAN BMS configuration file without receiving any CAN BMS message, it will assume that the CAN BMS communication has been disconnected and issue an "unsafe" warning.

When the user tries to run the test, the software will check whether CAN BMS meta variables are not defined or enabled in the CAN BMS configuration file in the Schedule. If so, a warning message will be given, and the test will not start.

13.4 Edit a CAN BMS File

13.4.1 Edit the Global Page

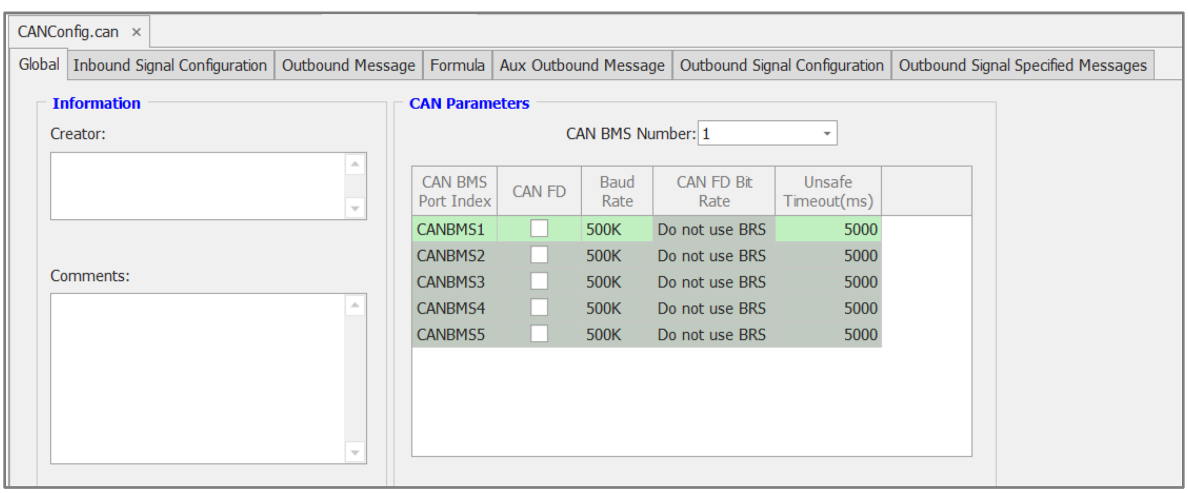


Figure 13-20 Global Page

1) **Creator** – The person who created this CAN BMS file.
2) **Comments** – Enter any descriptions related to this CAN BMS file.
3) **CAN BMS Number** – The number of CAN ports used in the actual test. Click the drop-down menu at CAN BMS Number and select the required number of CAN ports. Up to 5 are supported.

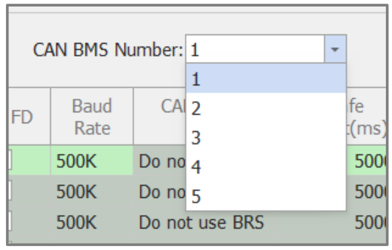
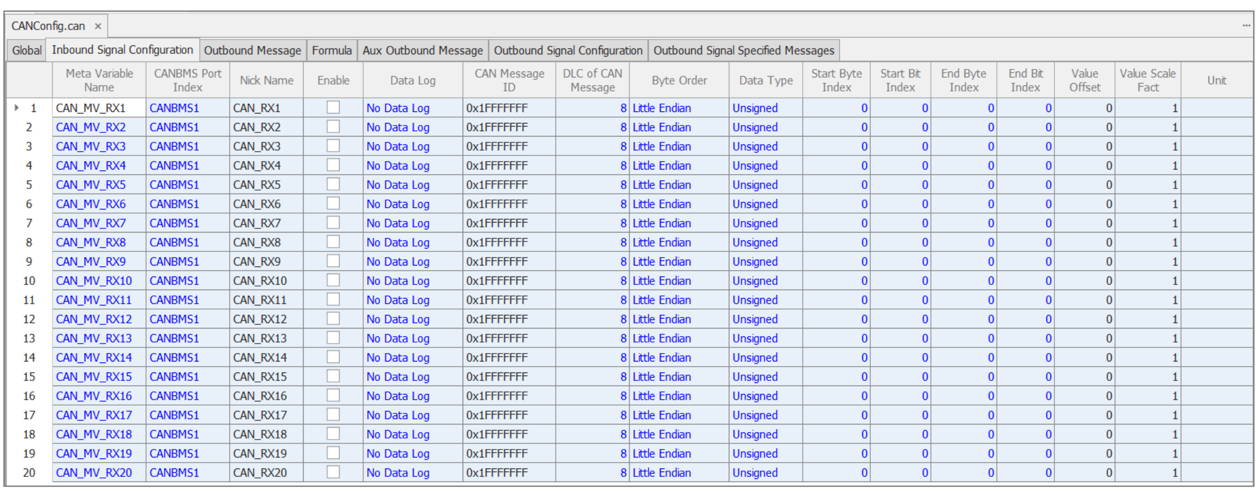


Figure 13-21 Select the Number of CAN Ports

4) **CAN BMS Port Index** – The sequence of CAN ports arranged in the Mapping table.
5) **CAN FD –** Whether to enable the CANFD function.
6) **Baud Rate** – 125K, 250K, 500K, 1M. The user must select the baud rate to match the CAN BMS baud rate.
7) **CAN FD Bit Rate** – Do not use BRS, 2M, 3M, 4M, 5M, 6M. Instead, the user must select the baud rate to match the CAN BMS baud rate.
8) **Unsafe Timeout (ms)** – CAN BMS unsafe timeout (milliseconds): If no CAN BMS signal is received for a while, an alarm will be issued, and the test will stop.

13.4.2 Edit the Inbound Signal Configuration Page

The user can define the received and parsed CAN BMS message information on this page.



CANConfig.can ×

Global | Inbound Signal Configuration | Outbound Message | Formula | Aux Outbound Message | Outbound Signal Configuration | Outbound Signal Specified Messages

	Meta Variable Name	CANBMS Port Index	Nick Name	Enable	Data Log	CAN Message ID	DLC of CAN Message	Byte Order	Data Type	Start Byte Index	Start Bit Index	End Byte Index	End Bit Index	Value Offset	Value Scale Fact	Unit
1	CAN_MV_RX1	CANBMS1	CAN_RX1	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
2	CAN_MV_RX2	CANBMS1	CAN_RX2	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
3	CAN_MV_RX3	CANBMS1	CAN_RX3	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
4	CAN_MV_RX4	CANBMS1	CAN_RX4	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
5	CAN_MV_RX5	CANBMS1	CAN_RX5	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
6	CAN_MV_RX6	CANBMS1	CAN_RX6	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
7	CAN_MV_RX7	CANBMS1	CAN_RX7	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
8	CAN_MV_RX8	CANBMS1	CAN_RX8	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
9	CAN_MV_RX9	CANBMS1	CAN_RX9	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
10	CAN_MV_RX10	CANBMS1	CAN_RX10	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
11	CAN_MV_RX11	CANBMS1	CAN_RX11	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
12	CAN_MV_RX12	CANBMS1	CAN_RX12	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
13	CAN_MV_RX13	CANBMS1	CAN_RX13	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
14	CAN_MV_RX14	CANBMS1	CAN_RX14	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
15	CAN_MV_RX15	CANBMS1	CAN_RX15	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
16	CAN_MV_RX16	CANBMS1	CAN_RX16	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
17	CAN_MV_RX17	CANBMS1	CAN_RX17	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
18	CAN_MV_RX18	CANBMS1	CAN_RX18	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
19	CAN_MV_RX19	CANBMS1	CAN_RX19	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	
20	CAN_MV_RX20	CANBMS1	CAN_RX20	☐	No Data Log	0x1FFFFFFF	8	Little Endian	Unsigned	0	0	0	0	0	1	

Figure 13-22 Inbound Signal Configuration Page

Inbound Signal Configuration Page Field Descriptions

1) **Meta Variable Name** – The meta variable name is predefined in Mits x and cannot be edited. Meta Variables are used to store the values of CAN signals and make them available to use in Schedule. The name is defined as CAN_MV_RXn, where n = 1, 2,...,2500. Figure 13-21: The CAN BMS value will be displayed in the "CAN BMS" Interface of the "Channel View" of the Monitor interface in the Console.

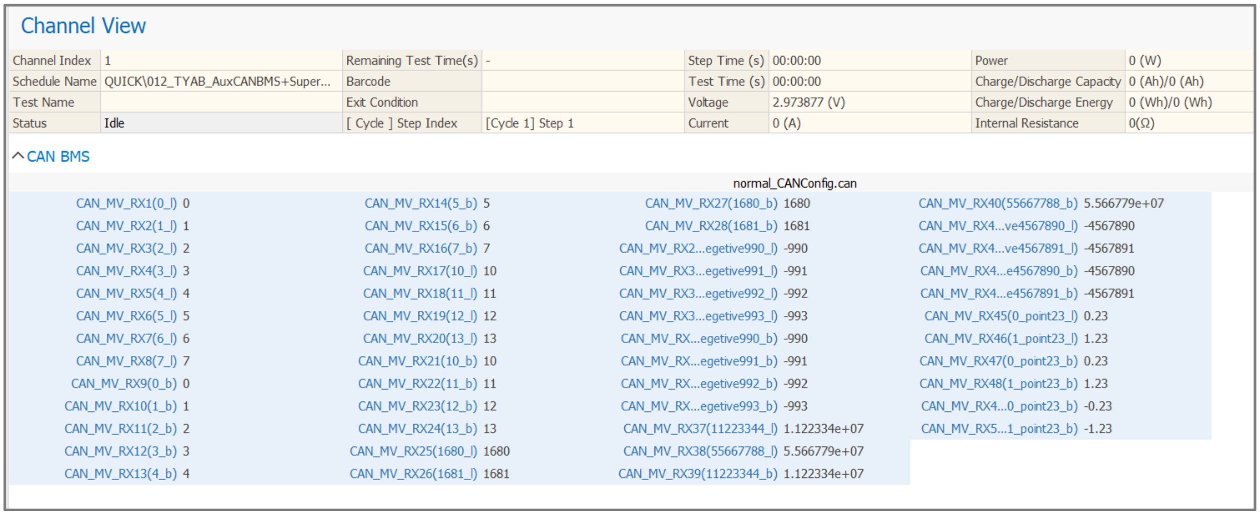


Figure 13-23 CAN BMS Value in Channel View

2) **CANBMS Port Index** – Used to describe the CAN port from which the CAN BMS message can be received.
3) **Nick Name** – Assign a meaningful name to the received CAN BMS signal. A good nickname will help users distinguish one signal from another. The default nickname is Can_RXn (n = 1, 2,...2500. The nickname is mainly used to display and record data. In the "Channel View", as shown in Figure 13-23, the nickname is displayed by following its Meta Variable name.
4) **Enable** – Check this check box to enable the definition of CAN BMS signals. If the signal is not enabled here, Mits X will ignore this definition and not sample, display, or record any data.

NOTE: Do not enable signals unless you need them, as this wastes computing resources.

5) **Data Log** – Set the data recording interval of the CAN BMS signal. If you select "No Data Log" for the enabled CAN signal, the data will not be recorded in the result file but will display in the observation Interface. Users can select an interval in the drop-down box to set the data log interval according to their needs.
6) **CAN Message ID** – The ID of the CAN BMS message containing the signal. Please note that the number entered here is decimal, and the system will convert it to hexadecimal automatically.
7) **DLC of CAN Message** – The DLC of the CAN BMS message containing the signal.
8) Please note that the software will use the CAN BMS message ID and the DLC to determine whether the received CAN BMS message is valid.
9) **Byte Order** – There are two options:

a) **Little Endian:** The least significant bit of Little-Endian byte order is located at the lowest address. It is also called the Intel format. The “start byte index” is not greater than the “end byte index” in the Little-Endian format.

EXAMPLE: If you pack one byte of data in the low-endian format, and the least significant bit is at 20 in Figure 13-24, the start byte index of the signal = 2, the start bit index = 4, and the end byte index = 3, end bit index = 3.

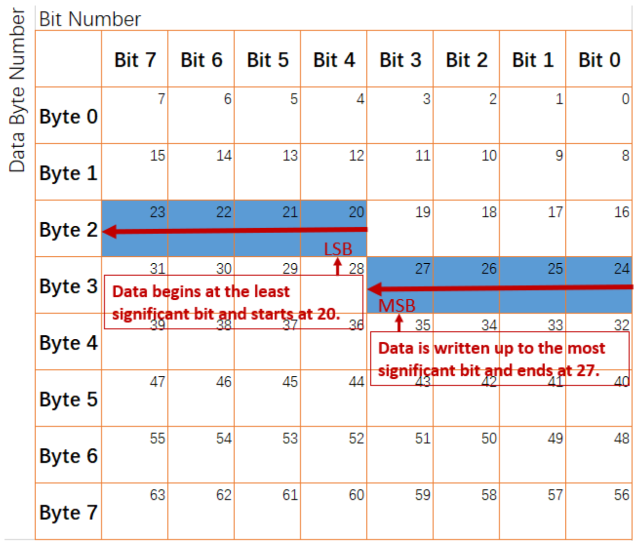


Figure 13-24 Little Endian

b) **Big Endian:** The least significant bit of the Big-Endian byte order is located at the highest address. It is also called the Motorola format. The “start byte index” is not less than the “end byte index” in the Big-Endian format.

EXAMPLE: If you pack one byte of data in big-endian format, and the least significant bit is 20 in Figure 13-25, the signal will have start byte index = 2, start bit index = 4, and end byte Index=1, end bit index=3.

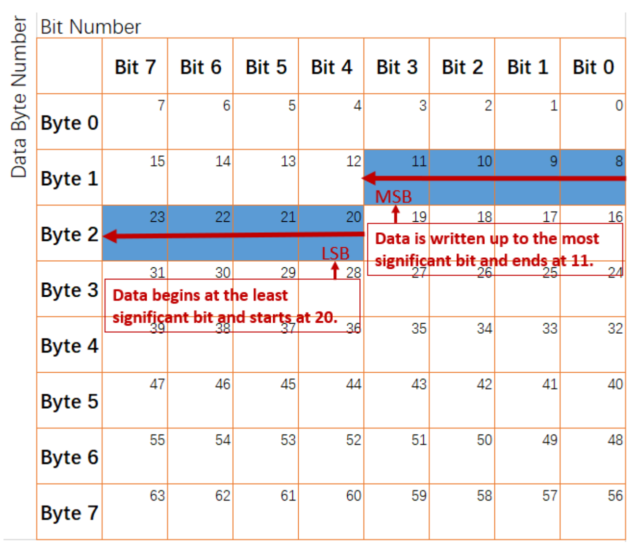


Figure 13-25 Big Endian

10) **Data Type** – Specify how the incoming CAN BMS data should be interpreted as unsigned data, signed data, and floating-point numbers.
11) **Start Byte Index** – Define the least significant byte of the signal. If the signal starts from the first byte of the 8-byte data, the starting byte index is 0. If the signal starts from the 8th byte of the 8-byte data, the starting byte index is 7.
12) **Start Bit Index** – The least significant bit of the signal is defined in the least significant byte. If the signal ends in the first bit of the least significant byte, the end bit index is 0. If the signal ends in the 8th bit of the least significant byte, the end bit index is 7.
13) **End Byte Index** – Define the most significant byte of the signal. If the signal ends at the first byte of the 8-byte data, the end byte index is 0. If the signal ends at the 8th byte of the 8-byte data, the end byte index is 7.
14) **End Bit Index** – Define the most significant bit of the signal in the most significant byte. If the signal ends in the first bit of the most significant byte, the end bit index is 0. If the signal ends in the 8th bit of the most significant byte, the end bit index is 7.
15) **Value Offset** – Specify the offset used to convert the original (CAN BMS data value) to its signal value.
16) **Value Scale Factor** – Specify the scale factor to convert the original (CAN data value) to its signal value.
17) **Unit** – Select the unit of CAN BMS signal. This unit will be used for display and data logging.

Edit the Inbound Signal Configuration Page

1) Add, Delete, Clone, Copy, and Paste:
   a) Right-click any row in the page, or select multiple rows and then right-click to select from Add, Delete, Clone, Copy and Paste operations.
   b) Left-click and double-click the index number on the left to add a row at the end.

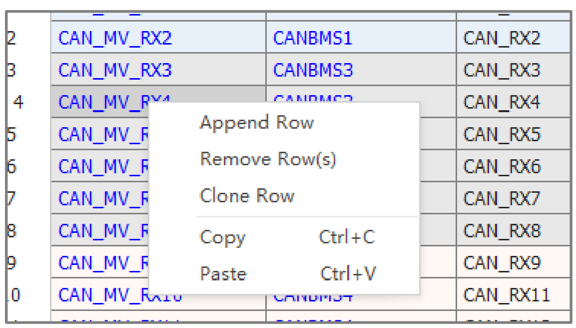


Figure 13-26 Add, Delete, Clone, Copy, and Paste

2) **Select All Columns** – Left-click on any column header position to select all columns.

3) **CAN BMS Port Selection** – Select the CAN BMS Port one of two ways:

a) Use the drop-down menu under the CAN BMS Channel Index column (as shown in Figure 13-27).

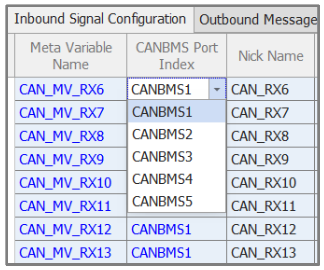


Figure 13-27 Select CAN BMS Port Method 1

b) Directly click the left mouse button, select the content to be modified in the drop-down, then right-click on the header of the column to select the CAN port (as shown in Figure 13-28).

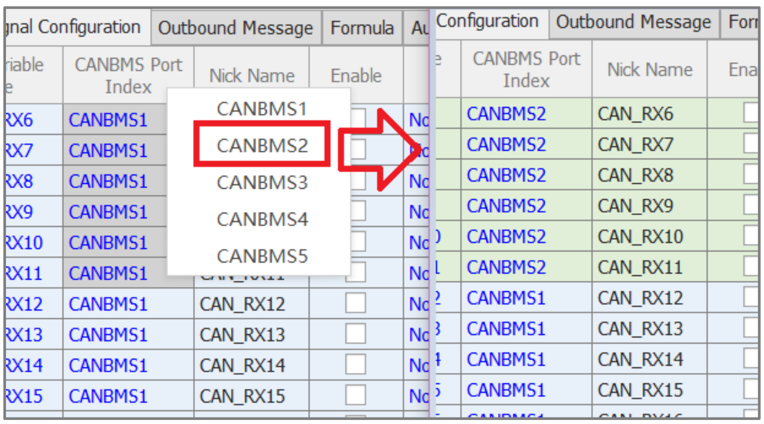


Figure 13-28 Select CAN BMS Port Method 2

4) **Check the Enable Box** – You can directly check the CAN BMS signal that you want to start, or right-click the header of the “Enable” list then choose to check all or uncheck all.

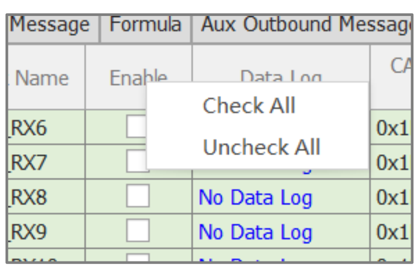


Figure 13-29 Check or Uncheck Enable for All

5) **Data Log Interval** – There are two methods to select the data log interval of the CAN BMS signal:

a) Click the cells in the Data Log column to select from the drop-down menu (Figure 13-30).

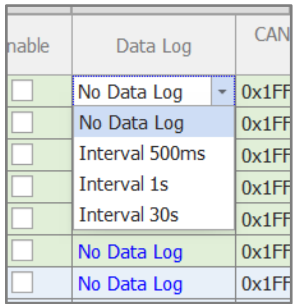


Figure 13-30 Data Log Interval Method 1

b) Left-click and drag to select multiple data logs, then right-click on the header to select the data log interval from the menu that appears (Figure 13-31).

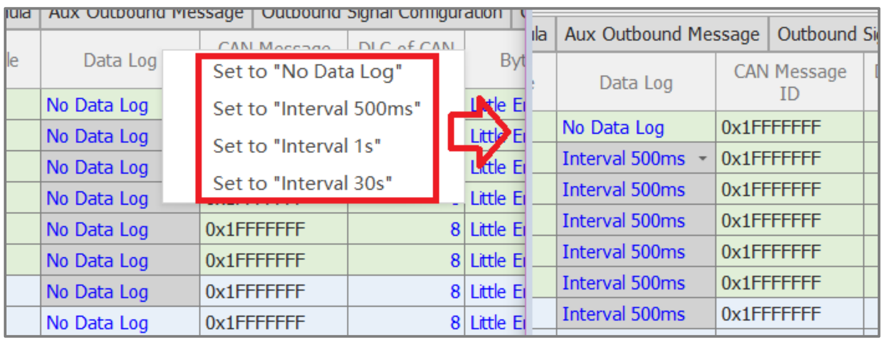


Figure 13-31 Data Log Interval Method 2

6) **CAN Message ID** – You can set the CAN Message ID in two ways:

a) Double-click the cell under the CAN Message ID column to begin editing.

b) Left-click and drag to select multiple CAN Message IDs, right-click on the CAN Message ID column header, enter the ID, and click "OK."

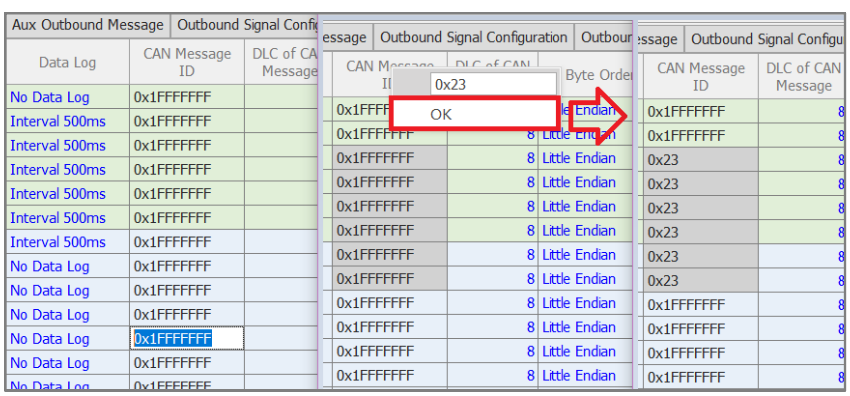


Figure 13-32 Two Methods to Set CAN Message ID

7) **DLC of CAN Message, Bytes Order, and Data Type** – There are two ways to choose the DLC of CAN Message, Bytes Order, and Data Type.

   a) Under the DLC of CAN Message, Bytes Order, or Data Type column in the DLC of CAN Message, left-click the cell and select from the drop-down list.

   b) Left-click and drag to select multiple rows, right-click the header of the DLC of CAN Message column, and select from the drop-down list.

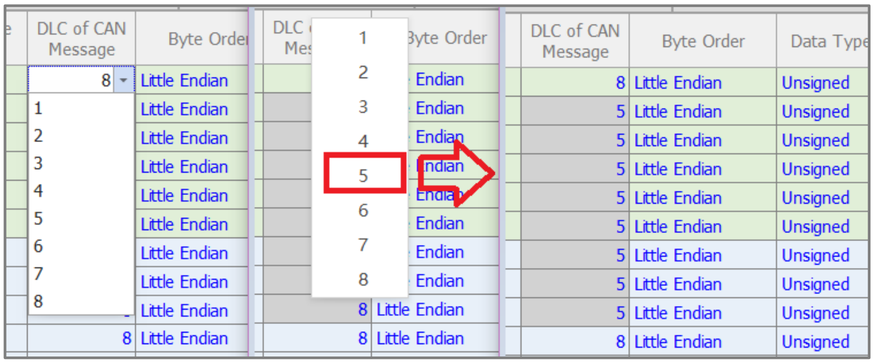


Figure 13-33 Two Methods to Set DLC of CAN Message

Figure 13-34 Two Methods to Set Byte Order

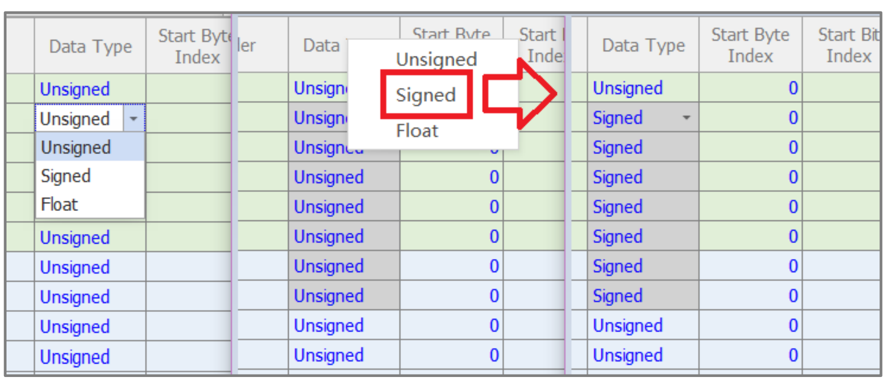


Figure 13-35 Two Methods to Set Data Type

8) **Start Byte Index, Start Bit Index, End Byte Index, End Bit Index** – Fill in these values by clicking on the cell and selecting the value from the drop-down list.

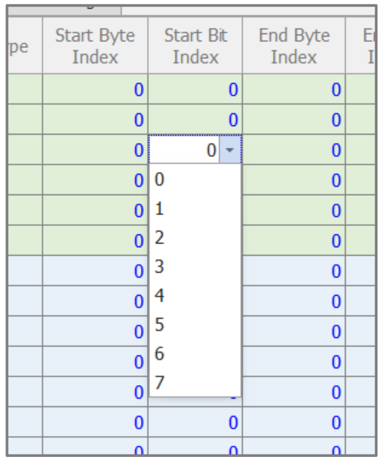


Figure 13-36 Select Value from the Drop-Down List

9) **Value Offset, Value Scale Factor, Unit** – There are two ways to set these values:
   a) Left-click the cell and edit the value.
   b) Left-click and drag to select multiple rows in the column, right-click on the header of the list, select the value, then click "OK."

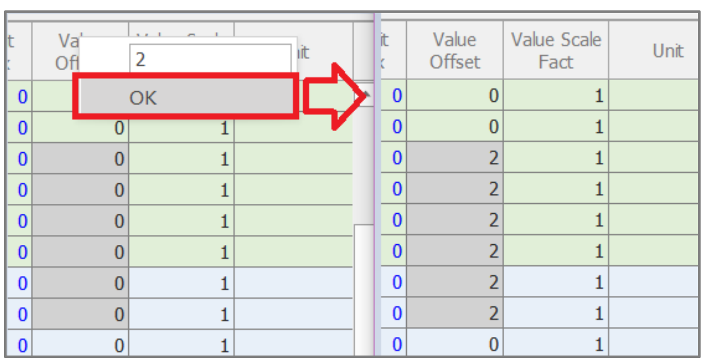


Figure 13-37 Modify Values of Multiple Rows

13.4.3 Edit the Outbound Message Page

Users can broadcast CAN BMS messages containing formulas, variables, and floating-point numbers to third-party CAN BMS devices.

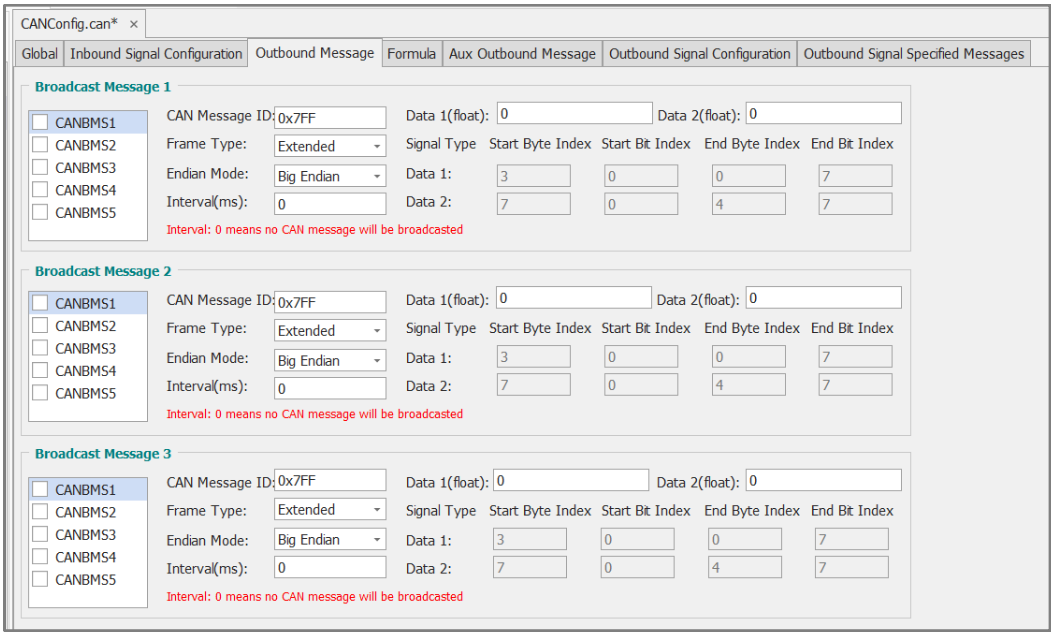


Figure 13-38 Outbound Message Page

1) **CAN Port Selection** – In each Broadcast Message position, click the left button to check the CAN port that needs to send broadcast.

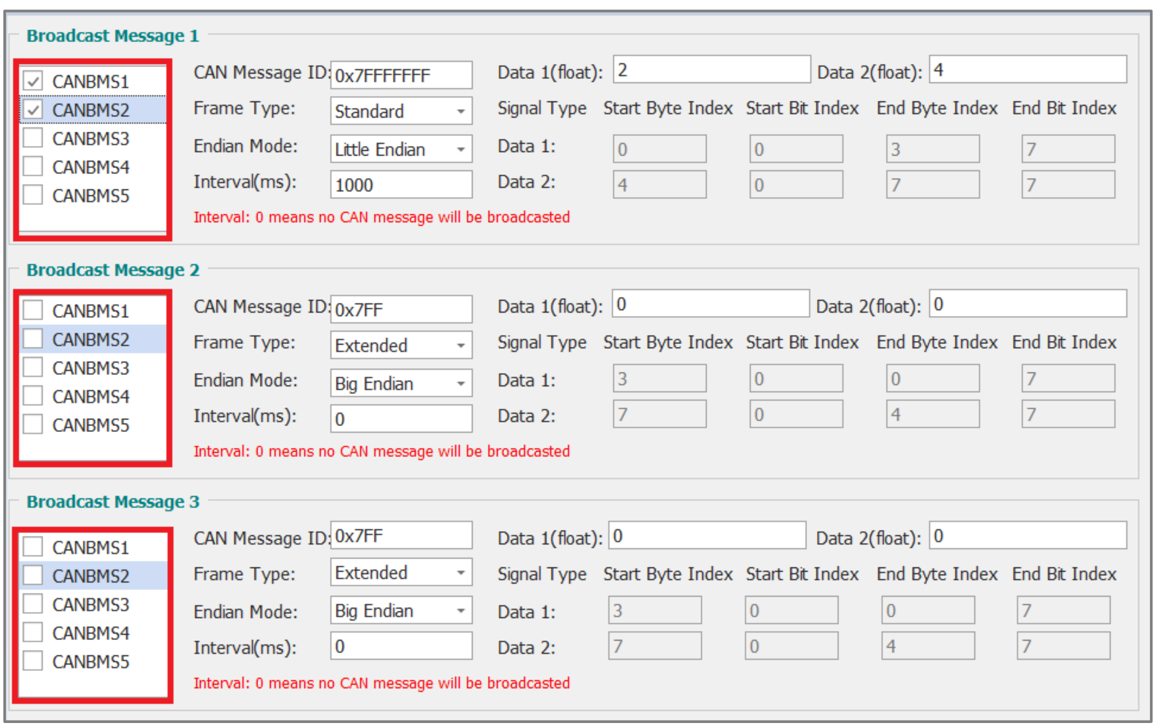


Figure 13-39 Selection of CAN Port

2) **Frame Type** – There are two types of frames:
   a) Standard frame – CAN BMS Message ID range of this type is 0x0-0x7FF.
   b) Extended frame – CAN BMS Message ID range is 0x0-0x1FFFFFFF.
3) **Interval** – Set the interval time for CAN BMS Message.
4) **Data (Float)** – Set data. You can also right-click on the edit box to select Formulas and Meta Variables.

13.4.4 Edit the Formula Page

The creation and editing of formulas on this page are similar formulas to Schedule Editor. For details, please refer to **6.6 Create and Edit Formulas**.

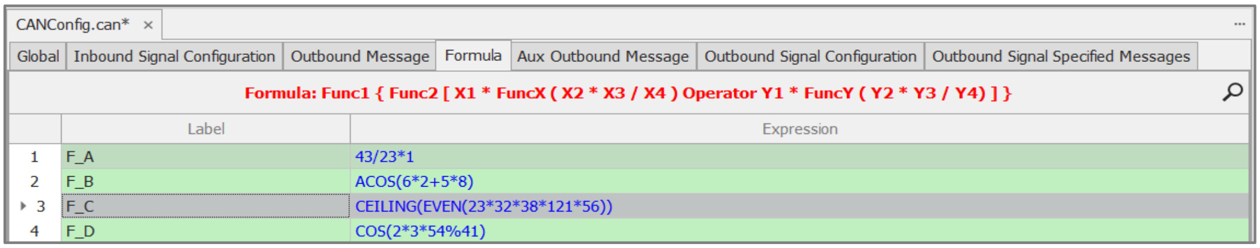


Figure 13-40 Formula Page

Search for a Formula

In addition, a search function has been added to the Formula page.

1) Click the icon in the upper right corner of the page.
2) Enter the content you are looking for in the search input box, which can be letters, numbers, symbols, etc.
3) Click on the "Find" button to the right of the search field to start the search.
4) After the search is complete, click the icon on the left side of the search box to end the search.

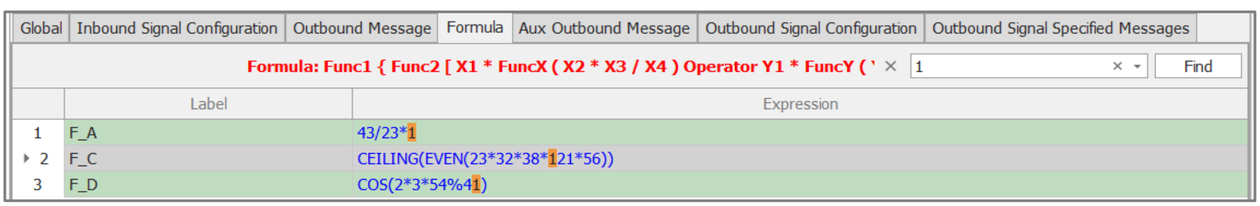


Figure 13-41 Find Formula

The conversion Formula from the received CAN data to its signal value is:

Signal_value = Raw_CAN_value * Scale_Factor + Offset

Among them, Raw_CAN_value is the value of CAN BMS data, and Signal_value is a linear conversion based on the original value of Scale_Factor and Offset.

NOTE: The maximum number of Formulas is 16.

13.4.5 Edit the Auxiliary Outbound Message Page

Users can broadcast auxiliary channel data on this page, such as Aux Temperature channel and Aux Voltage data.

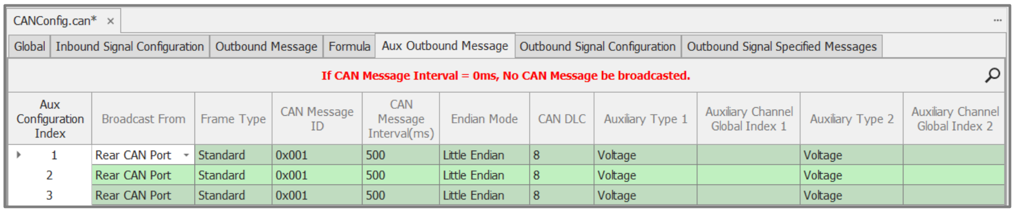


Figure 13-42 Aux Outbound Message Page

1) **Aux Configuration Index** – Index number of auxiliary configurations.
2) **Broadcast From** – Select the CAN BMS port of the auxiliary board, and the auxiliary CAN message will be broadcast on this port. There are two ports:
    a) The Rear CAN Port
    b) The Front CAN Port
3) **CAN Message Interval** – CAN BMS signal transmission interval time.
4) **CAN DLC** – If 4 is selected, only one auxiliary channel data can be broadcast. Otherwise, select 8 to broadcast two auxiliary channel data, but the two auxiliary channels in the same CAN frame must belong to the same auxiliary unit.
5) **Auxiliary Type** – Select the auxiliary type of the secondary channel. Only auxiliary temperature and auxiliary voltage are supported.
6) **Auxiliary Channel Global Index** – The global index of the auxiliary channel is referenced from the auxiliary page of the ArbinSys.cfg file.
7) Here you can also click the Search icon in the upper right corner of the page to search for the content you want.

NOTE: The maximum number of messages is 48.

13.4.6 Edit the Outbound Signal Configuration Page

Users can configure broadcast signals on this page.

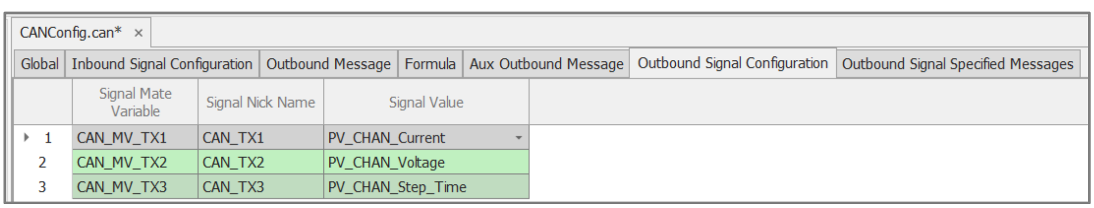


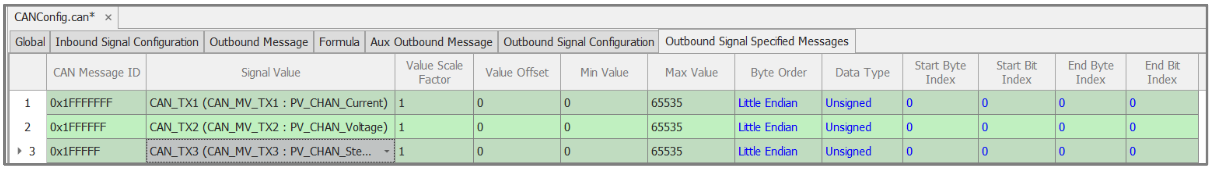
Figure 13-43 Outbound Signal Configuration Page

1) **Signal Mate Variable** – It is predefined in Mits X. The user cannot edit or change it.
2) **Signal Nick Name** – The user can assign a meaningful name to the broadcast CAN signal.
3) **Signal Value** – To select Meta Variables or Formulas. Click the cell and select the variable you need in the drop-down box. The value cannot be empty.

NOTE: The maximum configuration information is 32.

13.4.7 Edit the Outbound Signal Specified Messages Page

Users can define specific messages of the broadcast signal on this page. The Signal Value column cannot be empty, and the CAN Message IDs here cannot have the same name.



CANConfig.can*

Global | Inbound Signal Configuration | Outbound Message | Formula | Aux Outbound Message | Outbound Signal Configuration | Outbound Signal Specified Messages

	CAN Message ID	Signal Value	Value Scale Factor	Value Offset	Min Value	Max Value	Byte Order	Data Type	Start Byte Index	Start Bit Index	End Byte Index	End Bit Index
1	0x1FFFFFFF	CAN_TX1 (CAN_MV_TX1 : PV_CHAN_Current)	1	0	0	65535	Little Endian	Unsigned	0	0	0	0
2	0x1FFFFFF	CAN_TX2 (CAN_MV_TX2 : PV_CHAN_Voltage)	1	0	0	65535	Little Endian	Unsigned	0	0	0	0
3	0x1FFFFF	CAN_TX3 (CAN_MV_TX3 : PV_CHAN_Ste...	1	0	0	65535	Little Endian	Unsigned	0	0	0	0

Figure 13-44 Outbound Signal Specified Messages Page

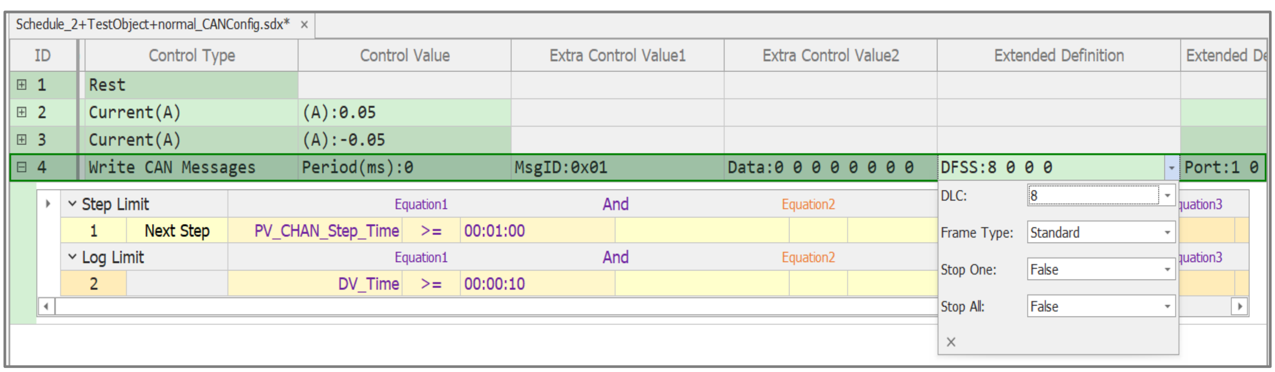
1) **CAN Message ID** – The ID of the CAN message containing the signal.
2) **Signal Value** – Available variables are selected on Outbound Signal Configuration page.
3) **Value Scale Factor** – Scale factor value.
4) **Value Offset** – Value offset.
5) **Min Value, Max Value** – A linear transformation is required when the variable type that needs to be broadcast does not match the [Min Value, Max Value] range.

NOTE: A maximum of 32 messages are allowed.

13.5 Use CAN BMS with a Test Schedule File

13.5.1 Select the Write CAN Messages Control Type

Select the control type: Write CAN Messages. This function can send fixed content CAN BMS messages during the running of the Schedule.



Schedule_2+TestObject+normal_CANConfig.sdx*

ID	Control Type	Control Value	Extra Control Value1	Extra Control Value2	Extended Definition	Extended De
1	Rest					
2	Current(A)	(A):0.05				
3	Current(A)	(A):-0.05				
4	Write CAN Messages	Period(ms):0	MsgID:0x01	Data:0 0 0 0 0 0 0 0	DFSS:8 0 0 0	Port:1 0

Figure 13-45 Write CAN Messages Control Type

The specific parameters of this function are as follows:

Field	Description	Notes
Control Value	CAN Message Period (ms)	0 for sending one-shot message
Extra Control Value1	CAN Message ID	
Extra Control Value2	CAN Message Data: Byte 0, Byte 1, Byte 2, Byte 3, Byte 4, Byte 5, Byte 6, Byte 7	Leave one space between Bytes
Extended Definition	DLC, Frame Type, Stop One, Stop All DLC=0-8 Frame Type: Standard=0, Extended=1 Stop One: Yes=1, No=0 Stop All: Yes=1, No=0	Leave one space between each flags
Extended Definition1	CAN BMS Port	Send CAN message from that Port

EXAMPLE 1: Write_CAN_Messages: 0, 110, 11 22 33 44 55 66 77 88, 8 1 0 0, CANBMS_Port_1. Means to send a one-click message in the following way:

- Time interval = 0ms
- CAN message ID = 110
- Byte 0 = 11; byte 1 = 22, byte 2 = 33, byte 3 = 44, byte 4 = 55, byte 5 = 66, byte 6 = 77, byte 7 = 88
- DLC = 8 Frame Type = Extended Stop current message = No Stop all = No
- Will be sent from the first CAN BMS port

EXAMPLE 2: Write_CAN_Messages: 200, 110, 11 22 33 44 55 66 77 88, 8 1 0 0, CANBMS_Port_1.

- Send CAN BMS message repeatedly:
- Time interval = 200ms
- CAN message ID = 110
- Byte 0 = 11; byte 1 = 22, byte 2 = 33, byte 3 = 44, byte 4 = 55, byte 5 = 66, byte 6 = 77, byte 7 = 88
- DLC = 8 frame type = extended stop current message = no stop all = no
- Will be sent from the first CAN BMS port

EXAMPLE 3: Write_CAN_Messages: x, 110, x x x 1 0, CANBMS_Port_1.

- Stop sending CAN BMS messages repeatedly:
- CAN message ID = 110
- Stop One = Yes, Stop ALL = No, x can be any number, such as 0
- Will be sent from the first CAN BMS port

EXAMPLE 4: Write_CAN_Messages: xxxxxxxx 1, CANBMS_Port_1.

- Stop sending all ongoing CAN messages repeatedly:
- Stop ALL = Yes, x can be any number, such as 0
- Will be sent from the first CAN BMS port

Use CAN BMS signal under Step Limit condition: In the drop-down variable, select More.

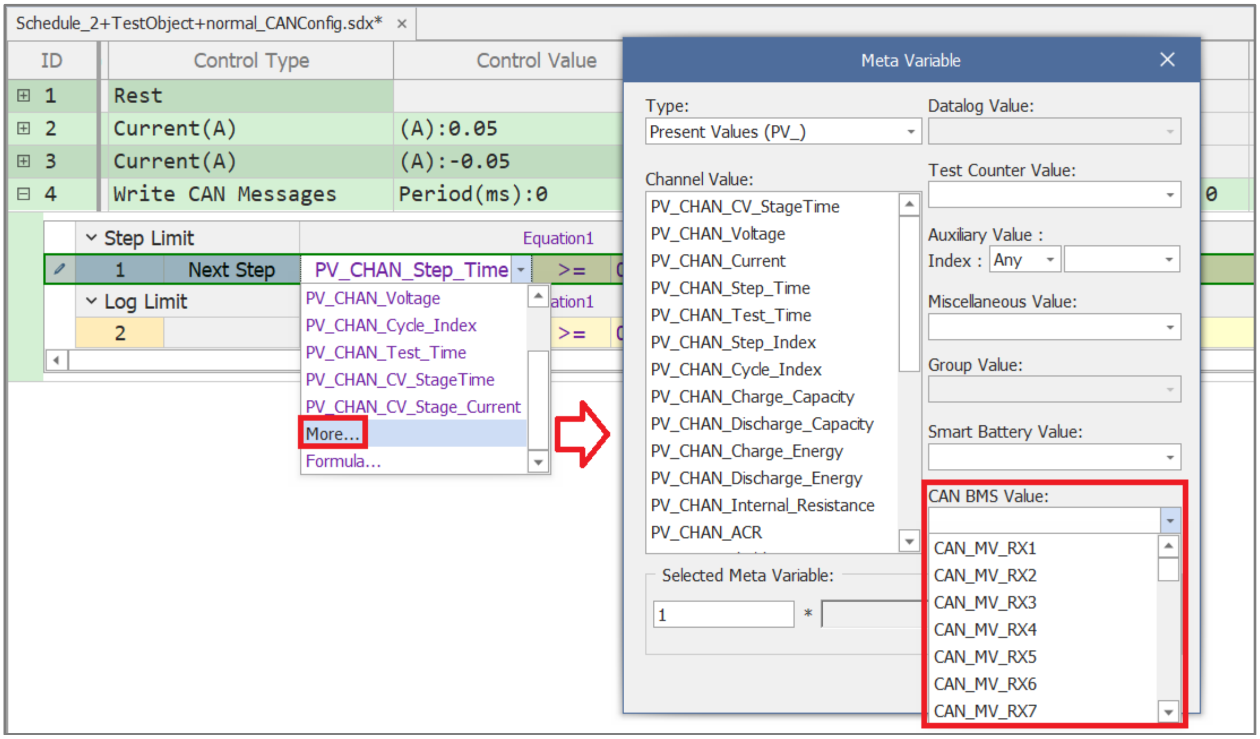


Figure 13-46 Use CAN Signal

13.5.3 Write the Signal Specified CAN Message Function

It broadcasts current, voltage, variable, or formula as CAN value.

1) Open the “Outbound Signal Configuration” page in the CAN BMS configuration file.
2) Right-click to add “Signal Mate Variable.”
3) Select the variable to be sent from the “Signal Value” drop-down list.

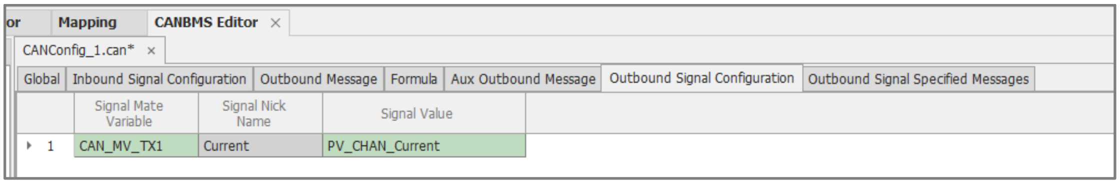


Figure 13-47 Configure Sending Variables

4) In the “Outbound Signal Specified Messages” page, “Signal Value” selects the CAN BMS signal and save the CAN BMS configuration file.

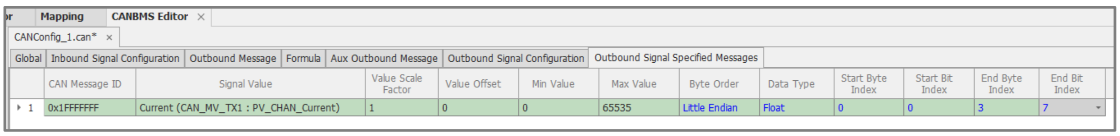


Figure 13-48 Choose to Send a Signal

5) Add a Step in the Schedule.
6) Select “Write Specified CAN Message” as the control type.
7) Fill in the necessary content, including Period, MsgID, and DFSS.

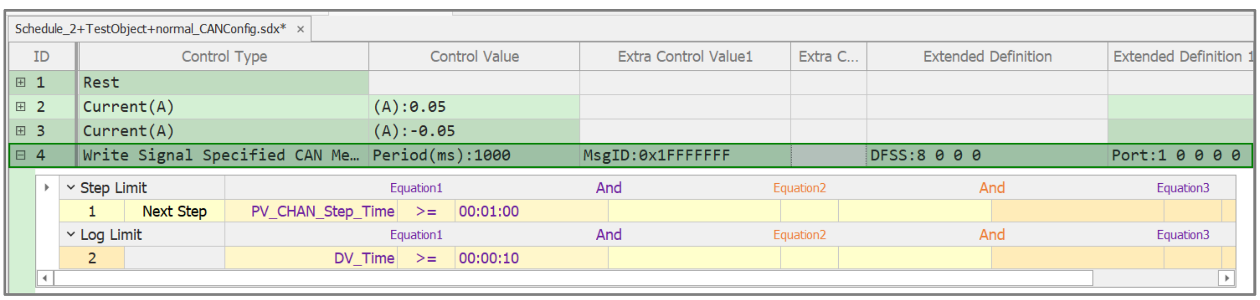


Figure 13-49 Set the Write Signal Specified CAN Message Control Type

EXAMPLE: for CAN_MV_TX1.

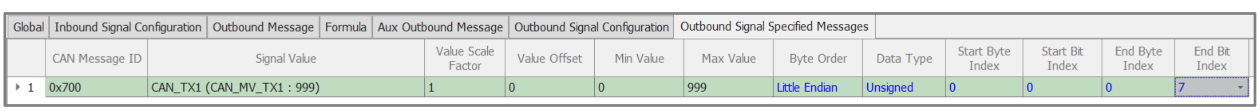


Figure 13-50 CAN_MV_TX1 Configuration

The Arbin cycler passes through, calculates the value, performs a linear transformation of the value, and then performs range protection. As shown in Figure 13-51:

$$[\mathbf{b}_{\mathbf{min}} = \mathbf{0}, \mathbf{b}_{\mathbf{max}} = \mathbf{255}]$$

SignalValue is 999, minValue is 0, maxValue is 999.

Finally, the value calculated by the Arbin cycler is: 255.

$$x = 999 * 1 + 0$$

$$x = \min\left(999, \max(0{,}999)\right)$$

Make sure to fall on the real number [0, 999].

$$x = \frac{999-0}{999-0} * (255 - 0) + 0 = 255.000$$

$out = 255 = [x]$ Take the integer value of x, round off the decimal

8) Next, set the value CAN BMS configuration quantity to 1 in the Aux Number And Safety section of the Global page.

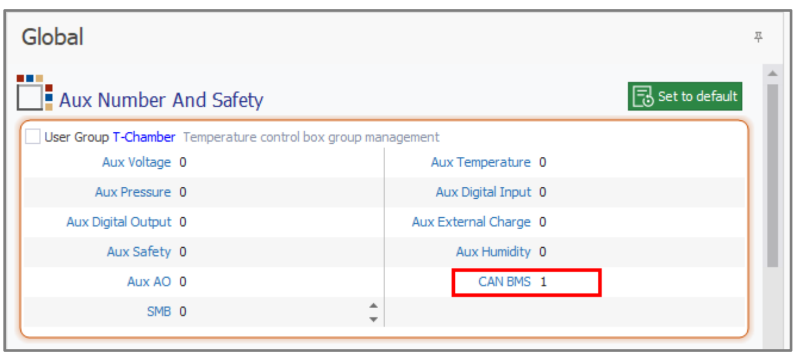


Figure 13-51 CAN BMS configuration quantity

13.6 Load CAN BMS Files

1) Right-click CANBMS on the interface and you can select:
   a) Assign CANBMS
   b) Clear CANBMS
   c) Open CANBMS

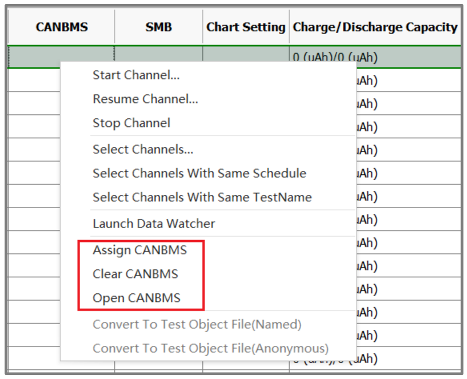


Figure 13-52 CAN BMS Right-Click Menu

2) Click "Assign CAN BMS" in the right-click menu of the CANBMS column of the Monitor interface.
3) In the pop-up dialog box, select the edited file to load.

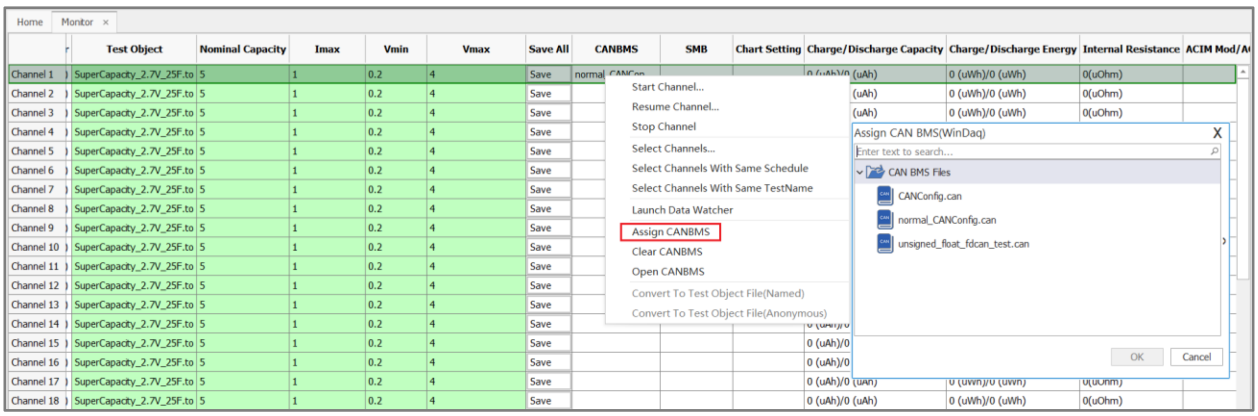


Figure 13-53 Detail View interface loading a CAN BMS file

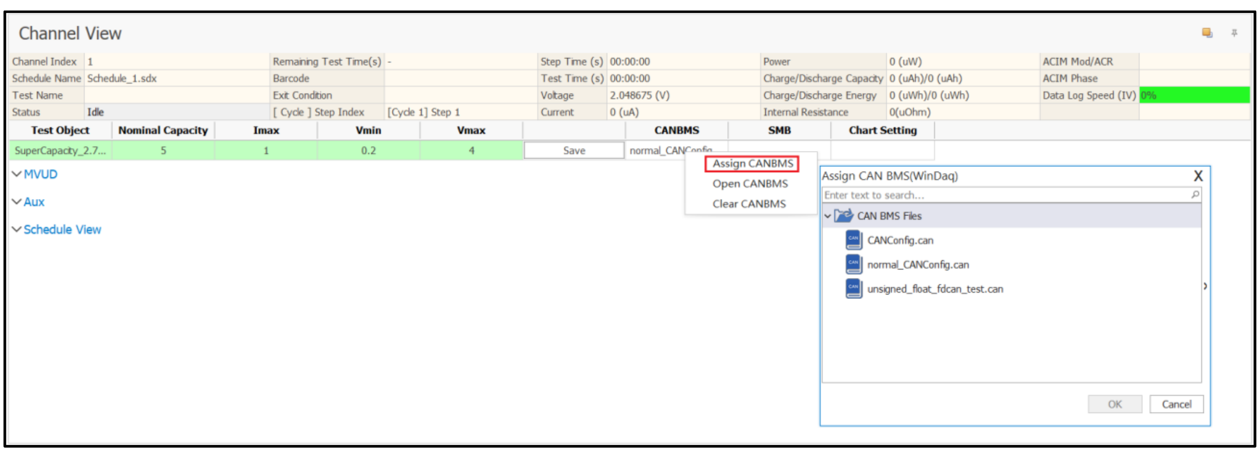


Figure 13-54 Channel View Interface for Loading a CAN BMS File

13.7 View the CAN BMS Signal and Data

13.7.1 View the Received CAN BMS Signal

In the “Channel View” of the Monitor Interface, the received CAN signal is displayed (Figure 13-55). The toolbar has the function of “Write CANBMS Message.” Please refer to section **10.2 Manage Tests with the Monitor Toolbar** for further details.

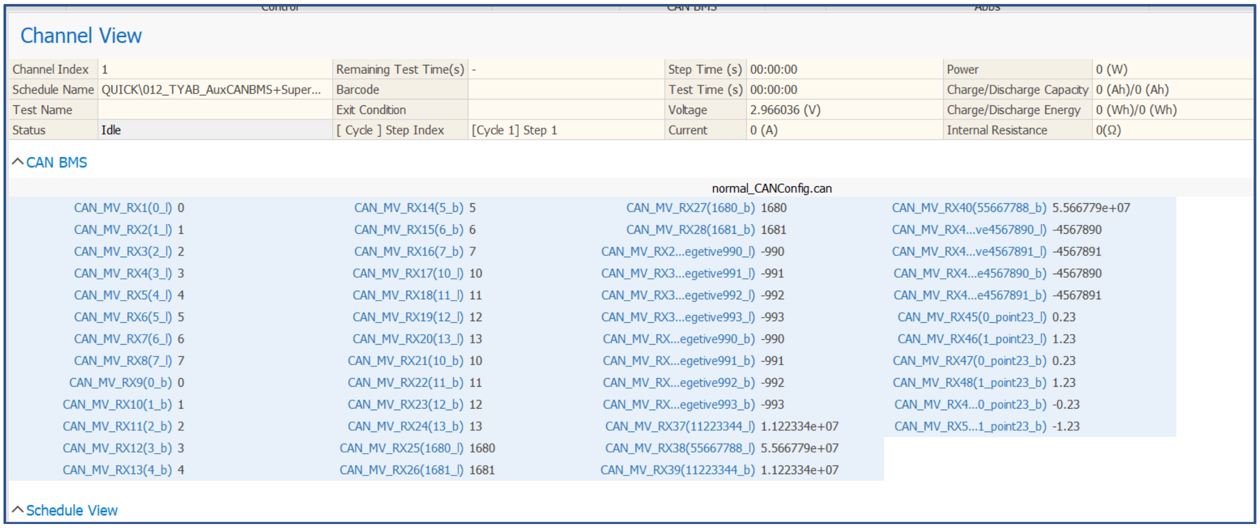


Figure 13-55 CAN BMS Signal Received

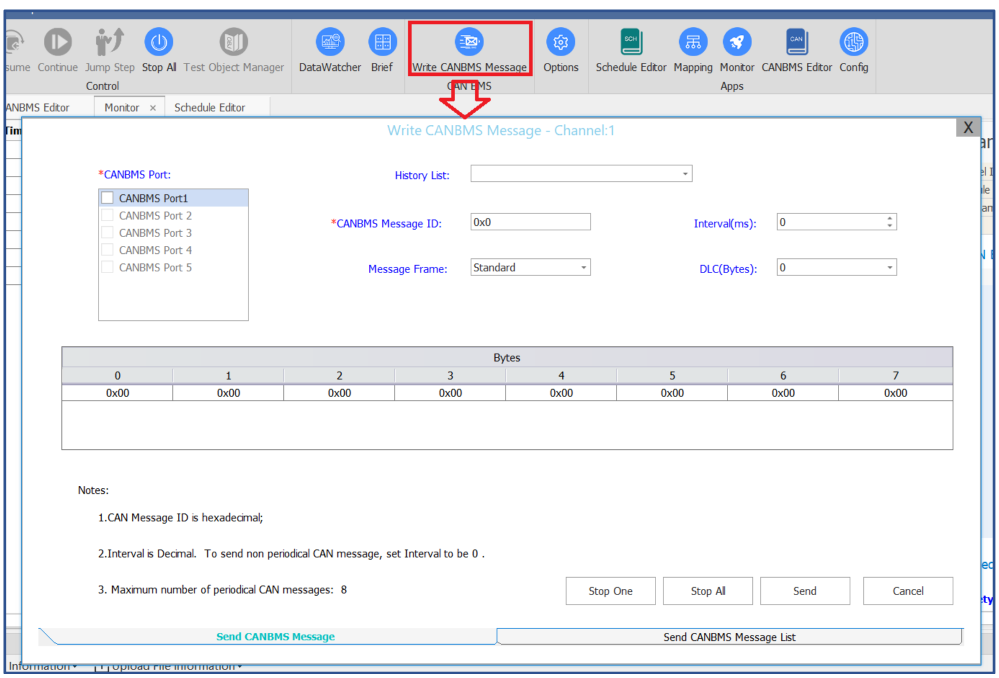


Figure 13-56 Write CAN BMS Message Function

13.7.2 Use DataWatcher to View Data

1) Start the DataWatcher software.
2) Click the “Add Test” or “Data Source” tab header on the DataWatcher homepage.
3) In the “Test Information” Interface that appears, select the test name.
4) Click “Export Test” to open the Export Interface.
5) Click to check the CAN BMS checkmark box and Single sheet box below.
6) Click on the “Export to Files” button to export the CAN BMS information and CAN data table to Excel.

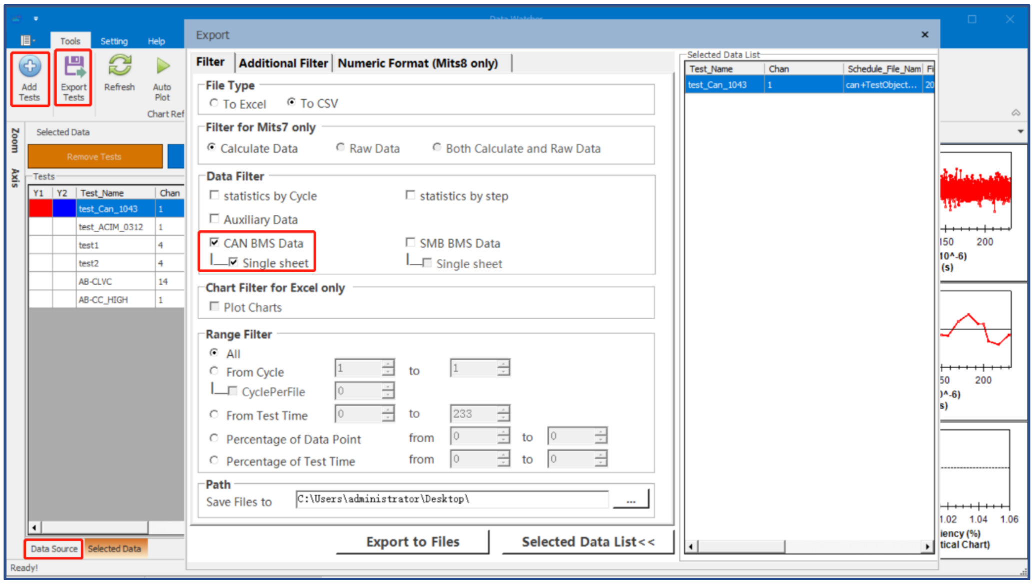


Figure 13-57 Export CAN Data

7) Open the Excel file to view the “CAN Information” and “CAN Data” tables. The following is CAN_Info. It includes information about enabled CAN signals:

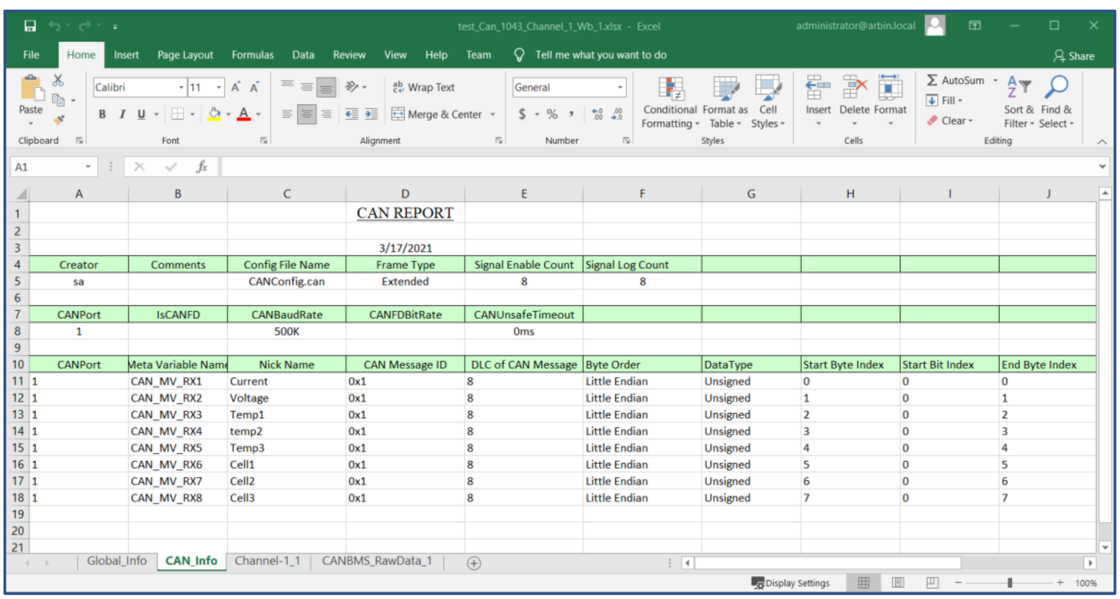
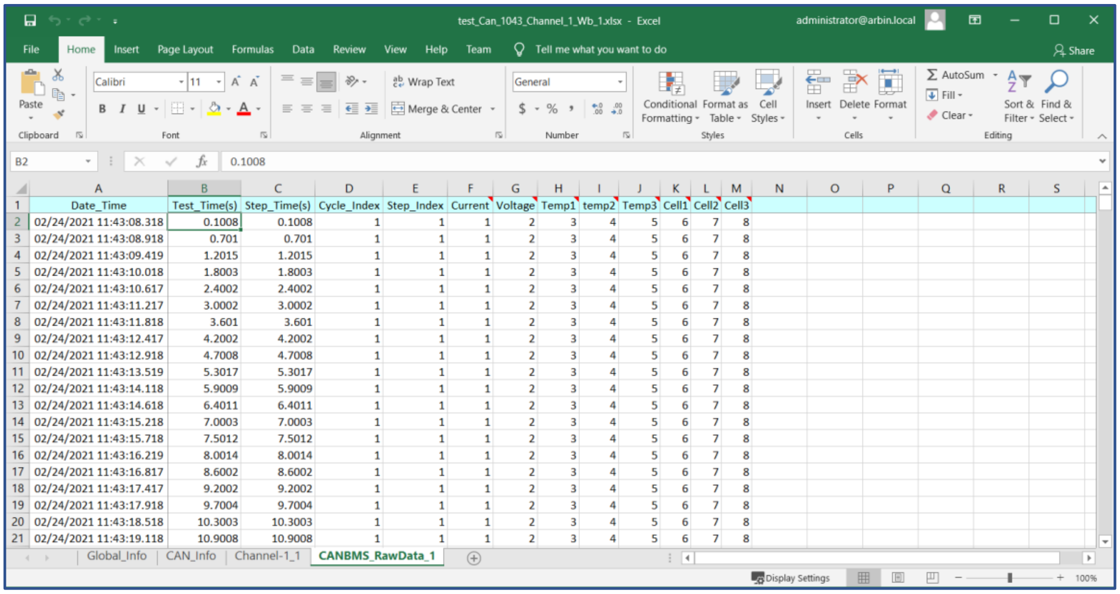


Figure 13-58 CAN Information Sheet



Date_Time	Test_Time(s)	Step_Time(s)	Cycle_Index	Step_Index	Current	Voltage	Temp1	temp2	Temp3	Cell1	Cell2	Cell3
02/24/2021 11:43:08.318	0.1008	0.1008	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:08.918	0.701	0.701	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:09.419	1.2015	1.2015	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:10.018	1.8003	1.8003	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:10.617	2.4002	2.4002	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:11.217	3.0002	3.0002	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:11.818	3.601	3.601	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:12.417	4.2002	4.2002	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:12.918	4.7008	4.7008	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:13.519	5.3017	5.3017	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:14.118	5.9009	5.9009	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:14.618	6.4011	6.4011	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:15.218	7.0003	7.0003	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:15.718	7.5012	7.5012	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:16.219	8.0014	8.0014	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:16.817	8.6002	8.6002	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:17.417	9.2002	9.2002	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:17.918	9.7004	9.7004	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:18.518	10.3003	10.3003	1	1	1	2	3	4	5	6	7	8
02/24/2021 11:43:19.118	10.9008	10.9008	1	1	1	2	3	4	5	6	7	8

Figure 13-59 CAN Data Sheet

14: SMB

14.1 Introduction to SMB

14.1.1 What is SMB?

The intelligent battery management system describes the requirements and interfaces of multiple intelligent battery components or component systems in the management system. It autonomously connects one or more batteries to supply power to the system, controls the charging of multiple storage batteries, reports the characteristics of the system power supply battery, etc. The safety of the system depends to a large extent on the SMB behavior.

14.1.2 The SMB Editor

Open the SMB Editor

1) Open the SMB Editor by double-clicking the SMB Editor icon on the Console home page.

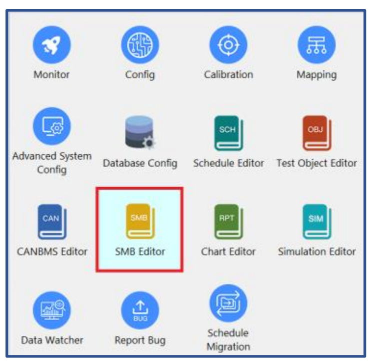


Figure 14-1 The SMB Editor Icon on the Console Home Page

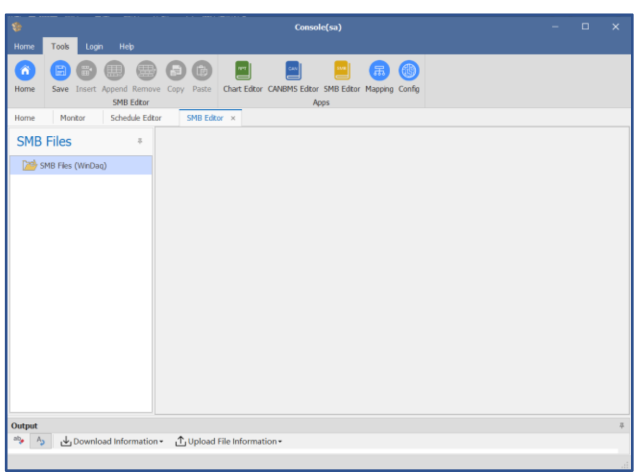


Figure 14-2 SMB Interface

Open the SMB Editor Locally

1) Right-click the SMB Editor icon to open SMB Editor locally.

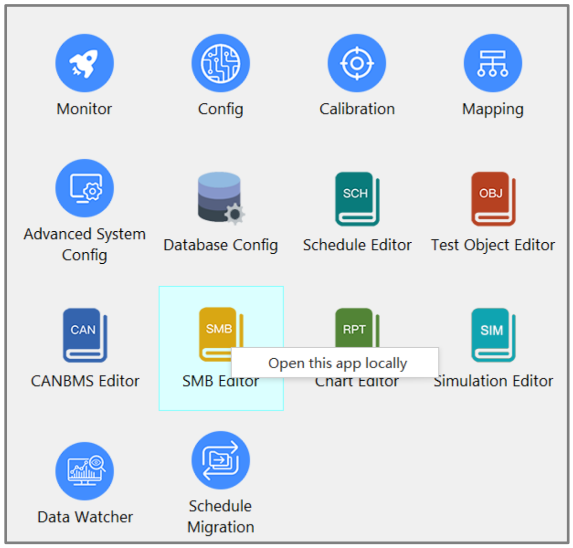


Figure 14-3 Open the SMB Editor Locally

14.1.3 The SMB Toolbar

The SMB Toolbar is shown in Figure 14-4 below.

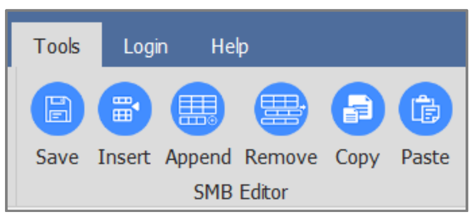


Figure 14-4 The SMB Toolbar

Save a Modified SMB File

1) Make any modifications to the SMB File (For more information, refer to **14.3 Edit an SMB File**).
2) Click on the "Save" icon in the SMB Toolbar to save the modified file.

Insert an SMB Data Row

1) On the SMB Data View page, select the row that you want to insert a row above.
2) Click on the "Insert" icon in the SMB Toolbar to insert a row of data above the selected row.

Add an SMB Data Row

1) On the SMB Data View page, click on the "Append" icon in the SMB Toolbar to insert a row of data in last position.

Delete and SMB Data Row

1) On the SMB Data View page, click on the row that you want to delete or left-click and drag to select multiple rows.
2) Click on the “Remove” icon in the SMB Toolbar to delete the selected row.

Copy and Paste an SMB Data Row

1) On the SMB Data View page, click the row you want to copy or left-click and drag to select multiple rows.
2) Click the “Copy” icon in the SMB Toolbar to copy the contents of the selected row(s).
3) Click the row to which you want to paste the data (or left-click and drag to select multiple rows).
4) Click on the “Paste” icon in the SMB Toolbar to successfully paste the copied content.

14.2 Prepare to Use SMB Files

14.2.1 System Configuration

Before you use any SMB features, you have to perform a system configuration. In the “Advanced Feature” page of the Advanced System Config, check the Smart Battery under the Normal list, and the Control Types related to the SMB test in the "Control Type" page.

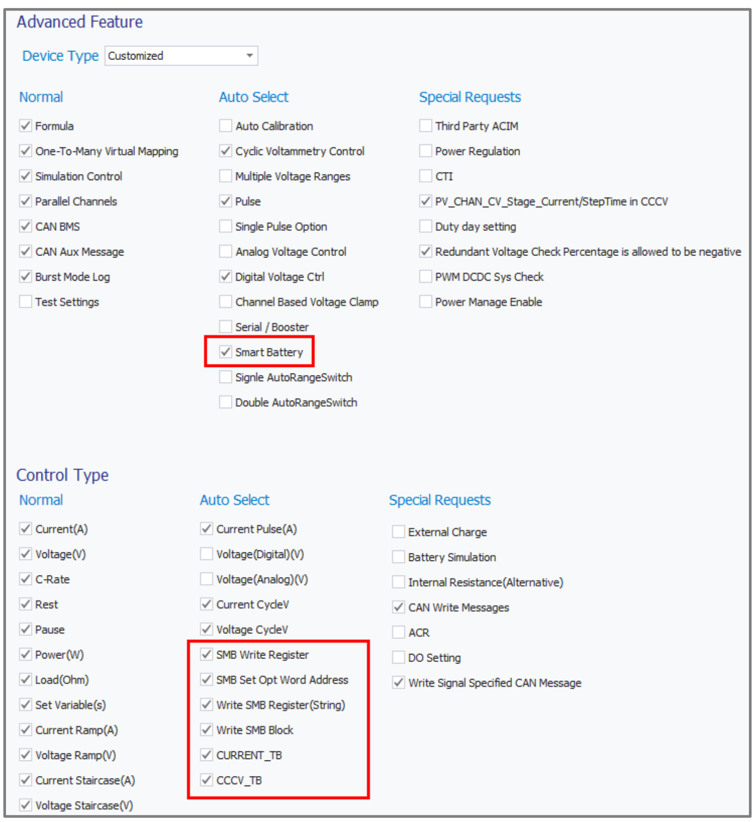


Figure 14-5 The SMB System Configuration

14.2.2 Modify Config

1) Enter the number of Units in Global Page.

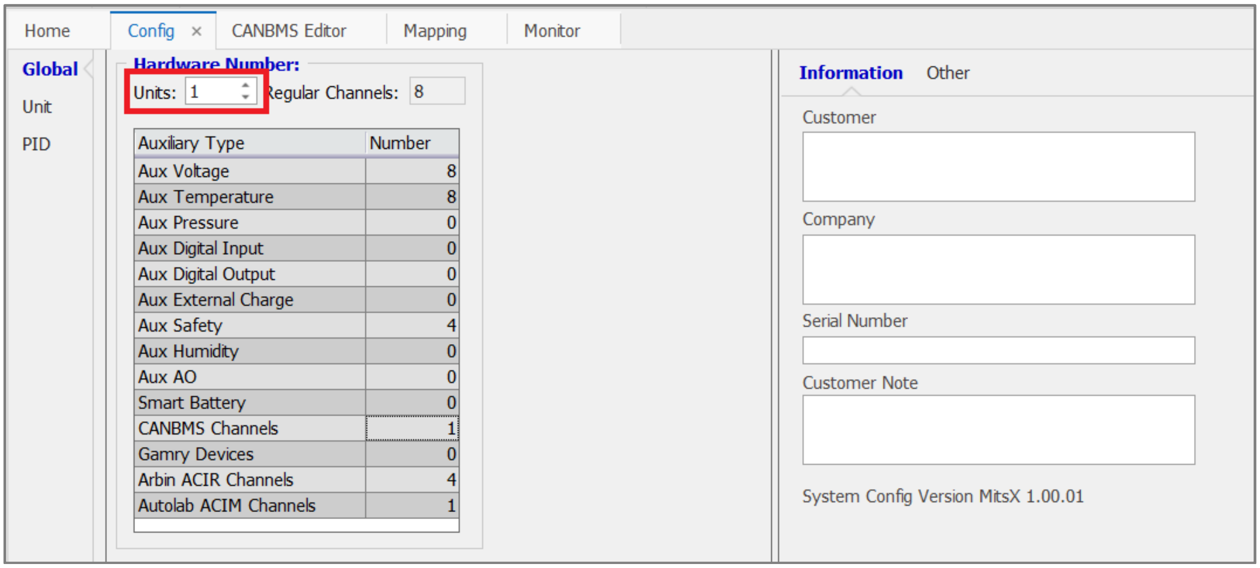


Figure 14-6 Enter the Number of Units

2) On the Unit page:
   a) Fill in the IP address of the SMB hardware device and the number of SMB channels in order.
   b) Download the System Config to the firmware.

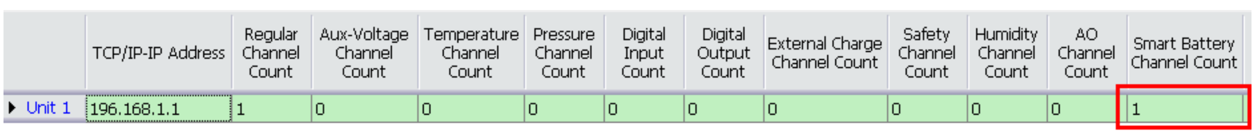


Figure 14-7 Setting Smart Battery Channel Count in Config

14.3 Manage SMB Files

14.3.1 Create a New SMB File

1) In the SMB File Directory, right-click the main SMB File Directory folder.
2) Click on the "New File" option in the menu that appears to create a new SMB File.

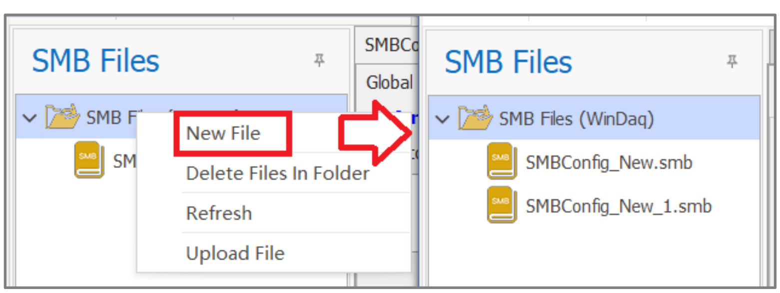


Figure 14-8 Create a New SMB File

14.3.2 Open an SMB File

Open an SMB File one of two ways:

1) Double-click on the SMB File you want to open the SMB File.
2) Right-click on the SMB File you want to open, then click on the “Open” option in the menu that appears to open the SMB File.

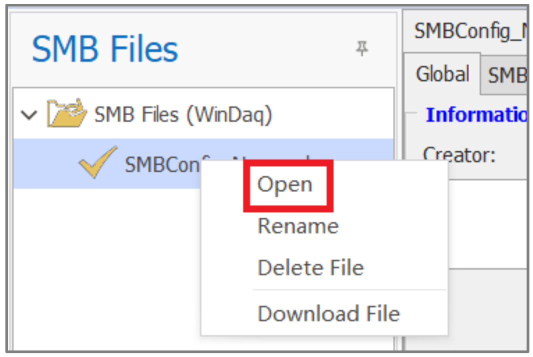


Figure 14-9 Open an SMB File

14.3.3 Upload an SMB File

1) In the SMB File Directory, right-click on the main SMB File Directory folder.
2) Click on the “Upload File” option in the menu that appears.
3) In the “Select Files” Interface that appears, navigate to and select the file to upload.
4) Click on the “Open” button at the bottom of the “Select Files” Interface to upload the selected file.

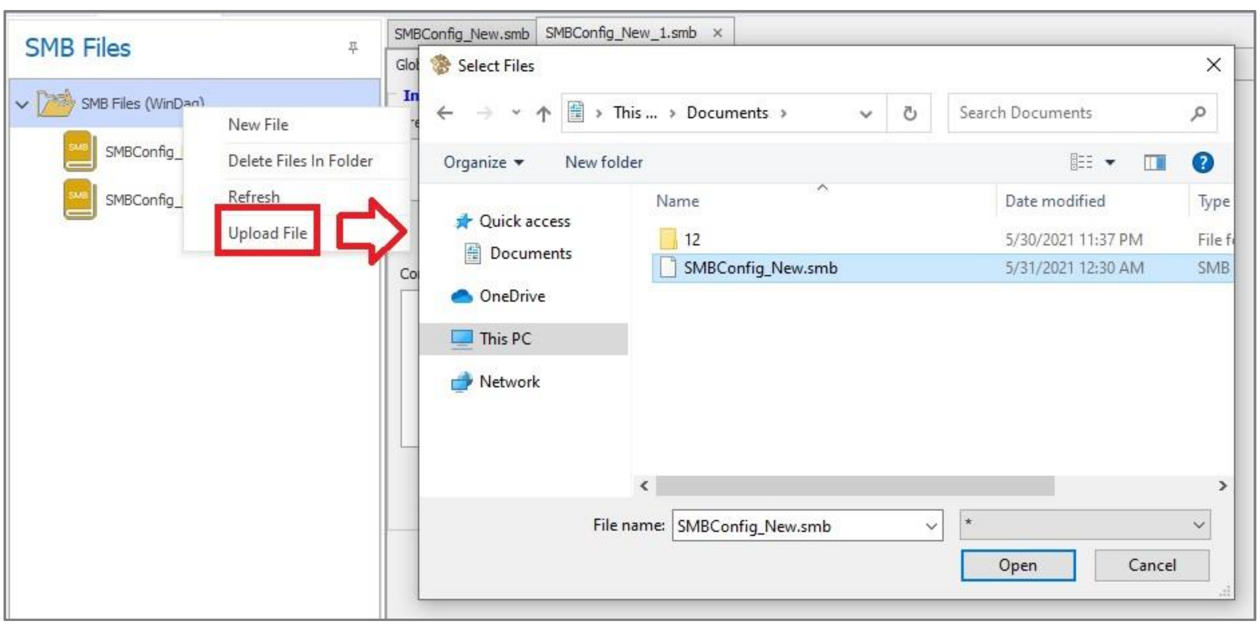


Figure 14-10 Upload an SMB File

14.3.4 Rename an SMB File

1) In the SMB File Directory, click on the SMB File you want to rename.
2) Click on the “Rename” option in the menu that appears.
3) In the “Rename” Interface that appears, enter the new file name in the name input field.
4) Click the “OK” button at the bottom of the “Rename” Interface to save the file name change.

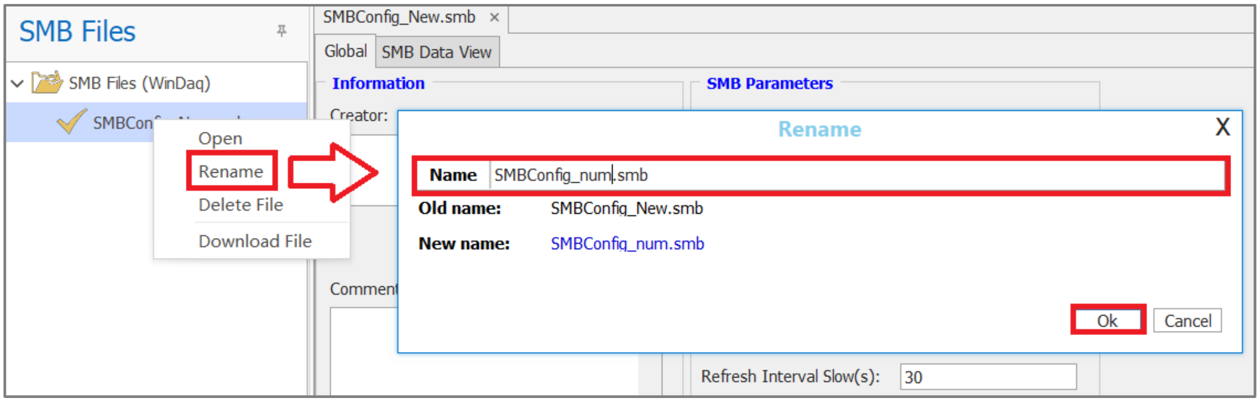


Figure 14-11 Rename an SMB File

14.3.5 Download an SMB File

1) In the SMB File Directory, right-click the SMB File you want to download.
2) Click on the “Download File” option in the menu that appears.
3) In the “Save As” Interface, select the location where you want to save the file.
4) Click on the “Save” button at the bottom of the “Save As” Interface to successfully download the selected file.

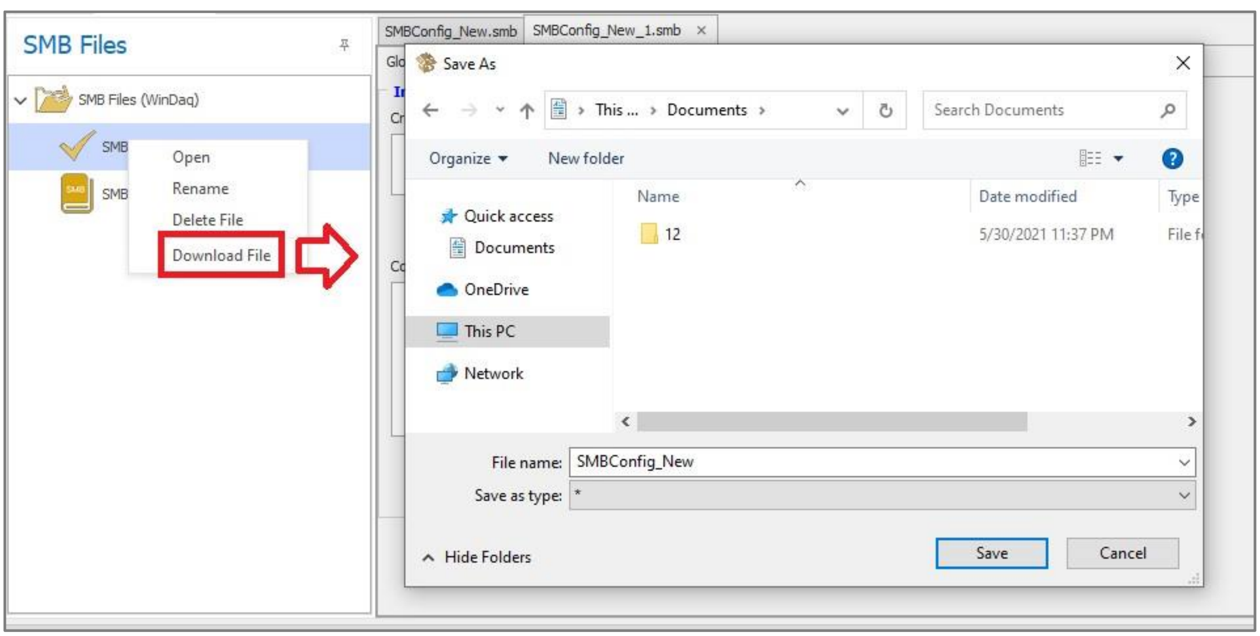


Figure 14-12 Download an SMB File

14.3.6 Delete SMB Files

Delete an SMB File

1) In the SMB File Directory, right-click on the SMB File you want to delete.
2) Click the "OK" button in the pop-up Interface that appears to successfully delete the selected file.

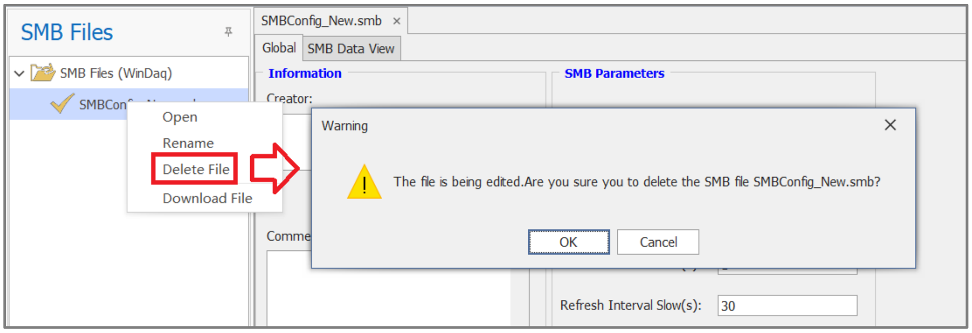


Figure 14-13 Delete an SMB File

Delete All SMB Files in the Directory

1) In the SMB File Directory, right-click on the main directory folder.
2) Click on the "Delete Files in Folder" option in the menu that appears.
3) Click on the "OK" button in the pop-up Interface that appears to delete all the files in the SMB File Directory.

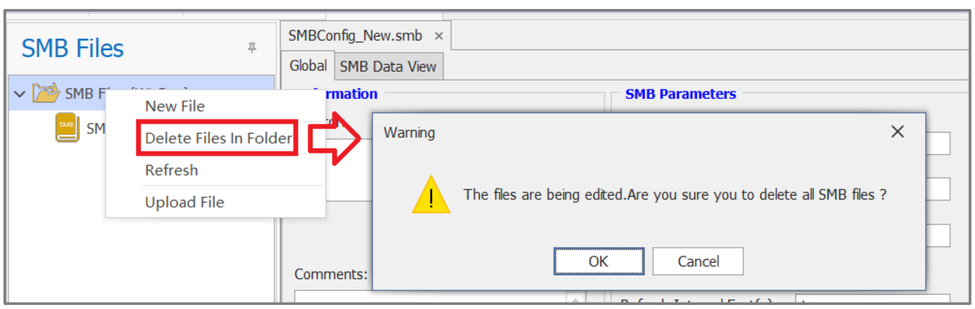


Figure 14-14 Delete all SMB File in the directory

14.3.7 Refresh the SMB File Directory

1) Right-click on the files in the SMB File Directory.
2) Click on the "Refresh" option in the menu that appears to refresh the SMB File Directory.

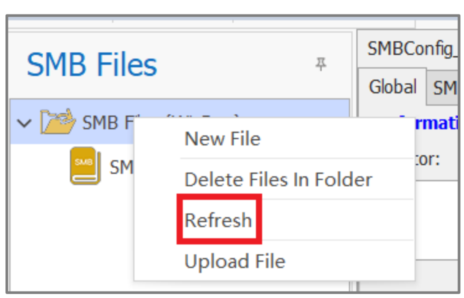


Figure 14-15 Refresh the SMB File Directory

14.4 Edit an SMB File

14.4.1 Edit the Global Page

SMB configuration page includes two parts: Information and SMB Parameters.

1) Information Includes:
   a) **Creator, Comments** – The internal creator and comments are used to fill in the user information text.
2) SMB Parameters Include:
   a) **Baud Rate(k)** – Identifies the set signal baud rate in KHz.
   b) **Cell Number** – Identification test battery number.
   c) **SMB Unsafe Timeout (ms)** – Identify the delay alarm time for judging signal abnormalities.
   d) **Refresh Interval Fast(s)** – Identifies the high-speed sampling signal refresh frequency.
   e) **Refresh Interval Slow(s)** – Identifies the refresh frequency of low-speed sampling signals.

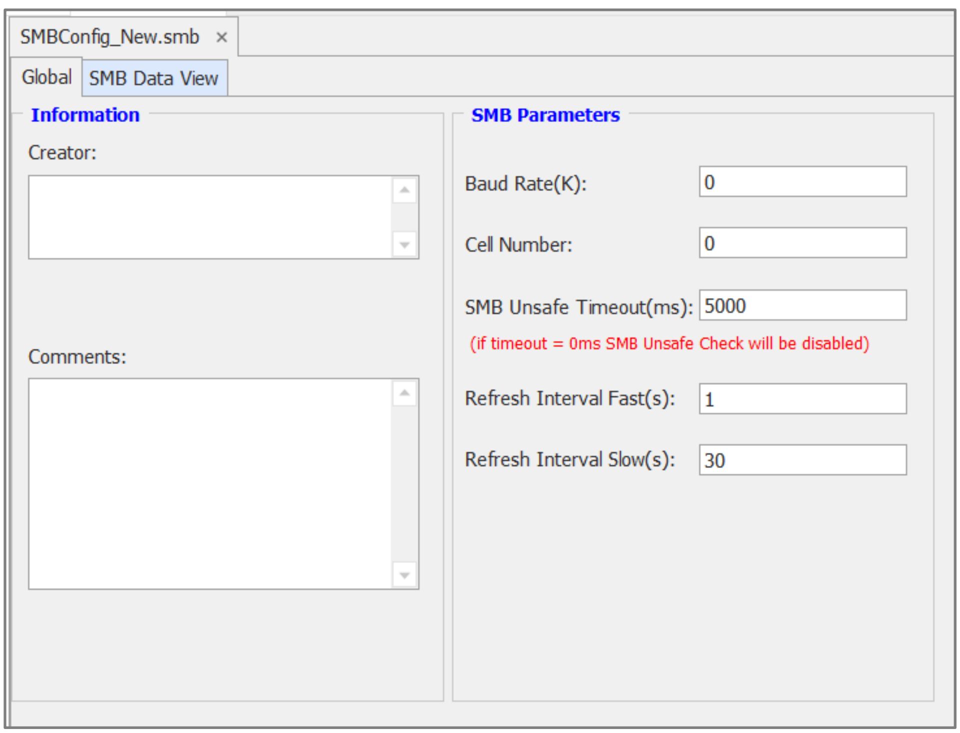


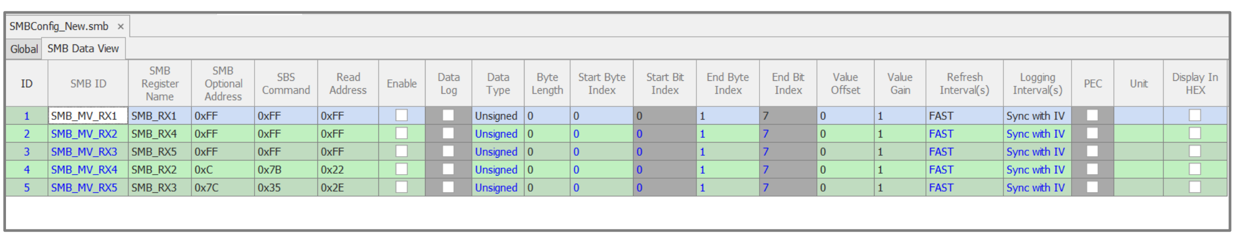
Figure 14-16 The SMB Global Page

14.4.2 Edit the SMB Data View

Field Descriptions

In the SMB Data View, the fields are the following:

1) **SMB ID** – Set SMB variable name.
2) **SMB Register Name** – User-defined variable name.
3) **SMB Optional Address** – Slave address of SMB battery.
4) **SBS Command** – SBS command code.
5) **Read Address** – The SMBBus address of SMB battery.
6) **Enable** – Enable/disable the register. If the register is enabled, the ChannelView interface will display the register information.
7) **Data Log** – Choose whether to record the read register data or to save it to the database.
8) **Data Type** – The type of sampling data recorded in the format. If you choose to display the HEX type, you need to check the Display in HEX dialog box.
9) **Byte Length** – Set the length of the read byte.
10) **Start Byte Index:** Valid first byte number of read string.
11) **Start Bit Index:** Reserved and not used.
12) **End Byte Index** – Valid end byte number of the read string.
13) **End Bit Index** – Reserved and not used.
14) **Value Offset** – Set the offset for the return value.
15) **Value Gain** – Set the gain for the return value.
16) **Refresh Interval(s)** – Refresh setting (fast/slow/once).
17) **Logging Interval(s)** – Recording interval setting (synchronized with IV/synchronized with refresh interval/customized).
18) **PEC** – Reserved and not used.
19) **Unit** – The user defines the unit of each read data.
20) **Display in HEX** – After selection, the return value is formatted into HEX type.


SMBConfig_New.smb ×

Global | SMB Data View

ID	SMB ID	SMB Register Name	SMB Optional Address	SBS Command	Read Address	Enable	Data Log	Data Type	Byte Length	Start Byte Index	Start Bit Index	End Byte Index	End Bit Index	Value Offset	Value Gain	Refresh Interval(s)	Logging Interval(s)	PEC	Unit	Display In HEX
1	SMB_MV_RX1	SMB_RX1	0xFF	0xFF	0xFF	☐	☐	Unsigned	0	0	0	1	7	0	1	FAST	Sync with IV	☐		☐
2	SMB_MV_RX2	SMB_RX4	0xFF	0xFF	0xFF	☐	☐	Unsigned	0	0	0	1	7	0	1	FAST	Sync with IV	☐		☐
3	SMB_MV_RX3	SMB_RX5	0xFF	0xFF	0xFF	☐	☐	Unsigned	0	0	0	1	7	0	1	FAST	Sync with IV	☐		☐
4	SMB_MV_RX4	SMB_RX2	0xC	0x7B	0x22	☐	☐	Unsigned	0	0	0	1	7	0	1	FAST	Sync with IV	☐		☐
5	SMB_MV_RX5	SMB_RX3	0x7C	0x35	0x2E	☐	☐	Unsigned	0	0	0	1	7	0	1	FAST	Sync with IV	☐		☐

Figure 14-17 SMB Data View

Edit the SMB Data View

1) Click the index number on the left side of the page and drop down to select multiple rows. Gray cells are not editable.
2) Double-click the index number on the left side of the page to add a row of data.
3) Set SMB Optional Address, SBS Command, Read Address.
   a) To edit a single value: Click on a single cell to input the value.
   b) To edit multiple values:
      i) Click the index number on the left and drag to select multiple rows.
      ii) Right-click on the column you want to edit to input the values for the selected rows one at a time in the "Input" Interface.
      iii) Click the "OK" button at the bottom of the "Input" Interface.
   c) When you enter a decimal value here, the system will convert it to hexadecimal automatically.

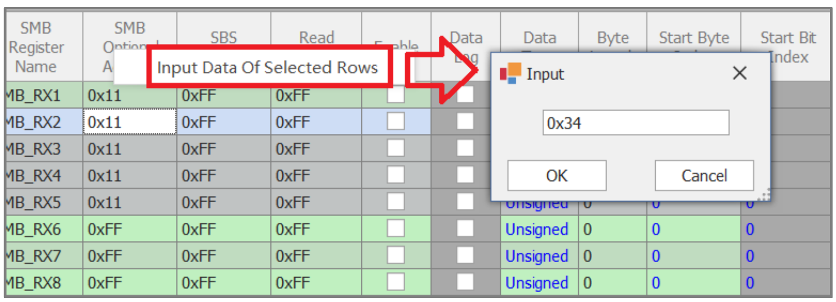


Figure 14-18 Enter All Rows of Data at Once

4) Right-click the Enable and Data Log columns to check all or uncheck all.

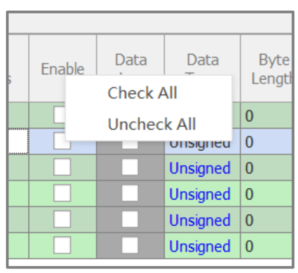


Figure 14-19 Right Click Options for Enable and Data Log

5) Select Data Type – Click to select the type you need in the drop-down list.

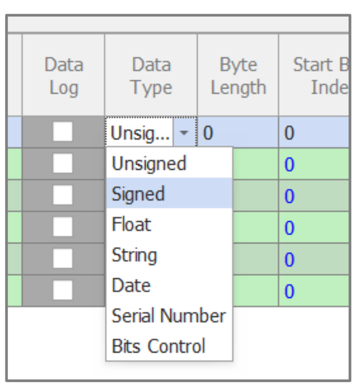


Figure 14-20 Select Data Type

6) Set the refresh interval.
    a) Click the cell under the Refresh Interval column to select fast, slow, or refresh once.
    b) Right-click on the Refresh Interval column to choose to clear all rows, set all rows to fast, set all rows to slow, and set all rows to refresh.

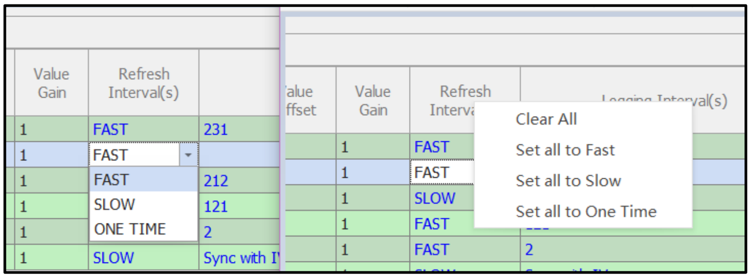


Figure 14-21 Two Methods to Set the Refresh Interval

7) Set the logging interval.
    a) Click the cell under the Logging Interval column to synchronize with IV, synchronize with the refresh interval, or customize.
    b) Right-click the Logging Interval column to clear all rows, set all rows to synchronize with IV, set all rows to synchronize with the refresh interval, and set all rows to custom.

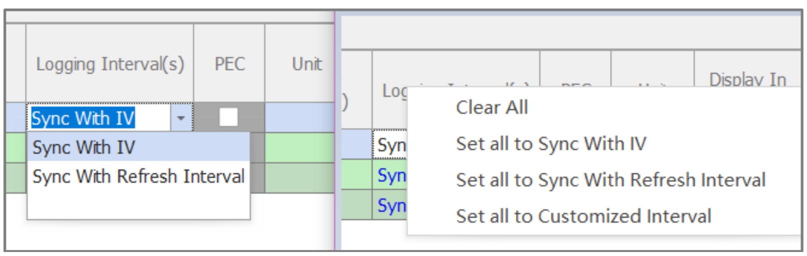


Figure 14-22 Set the Logging Interval

8) Right-click any row in the table or select multiple rows. You can choose to copy, paste, add, and delete rows.

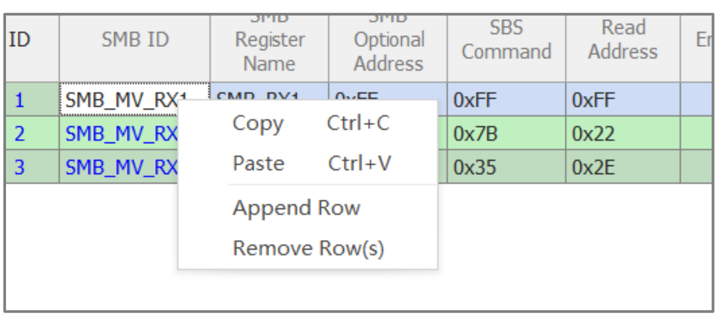


Figure 14-23 Right-Click Menu

14.5 Using SMB

14.5.1 Configure SMB in Mapping

In the “Mapping” Page, the user needs to map the SMB channels to the IV channels.

Figure 14-24 Mapping SMB Channels to I/V Channels

Note that once a channel is assigned an SMB profile, an active SMB must be connected. If the system exceeds the Unsafe time set in the SMB Configuration File without receiving any SMB messages, SMB communication will be assumed to be disconnected and an "unsafe" warning will be issued.

When you attempt to run a test, the software checks the Schedule for SMB Meta Variables that are not defined or enabled in the SMB Configuration File. If there is, a warning message will pop up and the test will not start.

14.5.2 Load SMB Files

1) Right-click the SMB of the interface and you can choose to:
   a) Assign SMB
   b) Clear SMB
   c) Open SMB

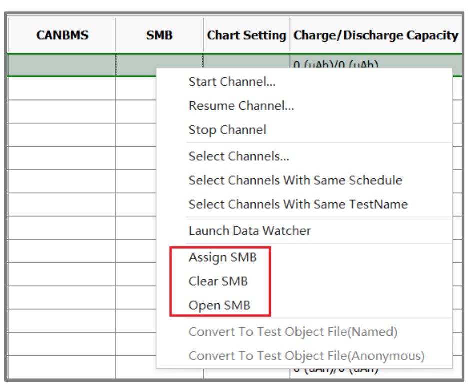


Figure 14-25 SMB Right-Click Menu

2) Click Assign SMB in the right-click menu of the SMB column of the Monitor interface.
3) Select the edited file to load in the pop-up dialog box.

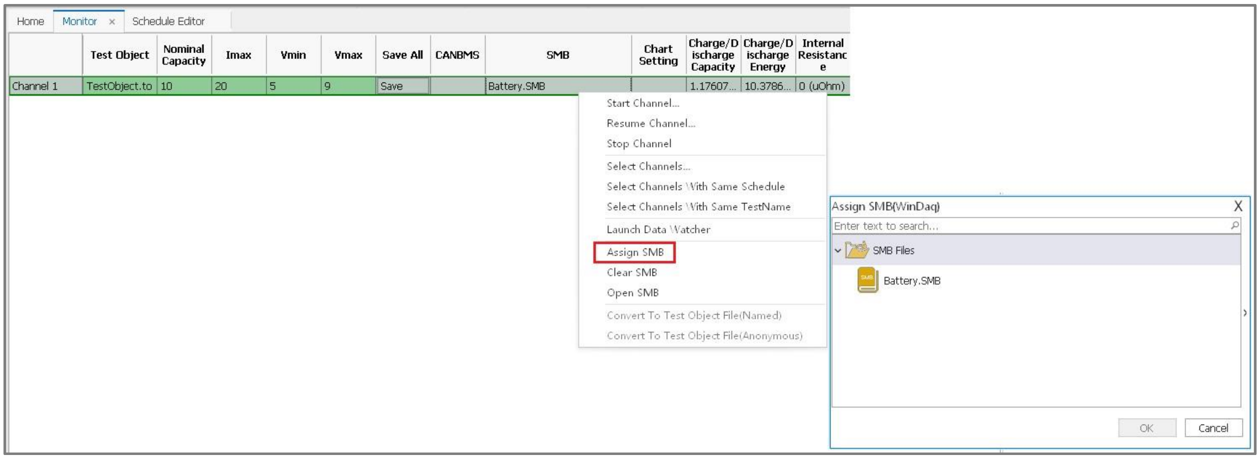


Figure 14-26 Detail View Interface to Load an SMB File

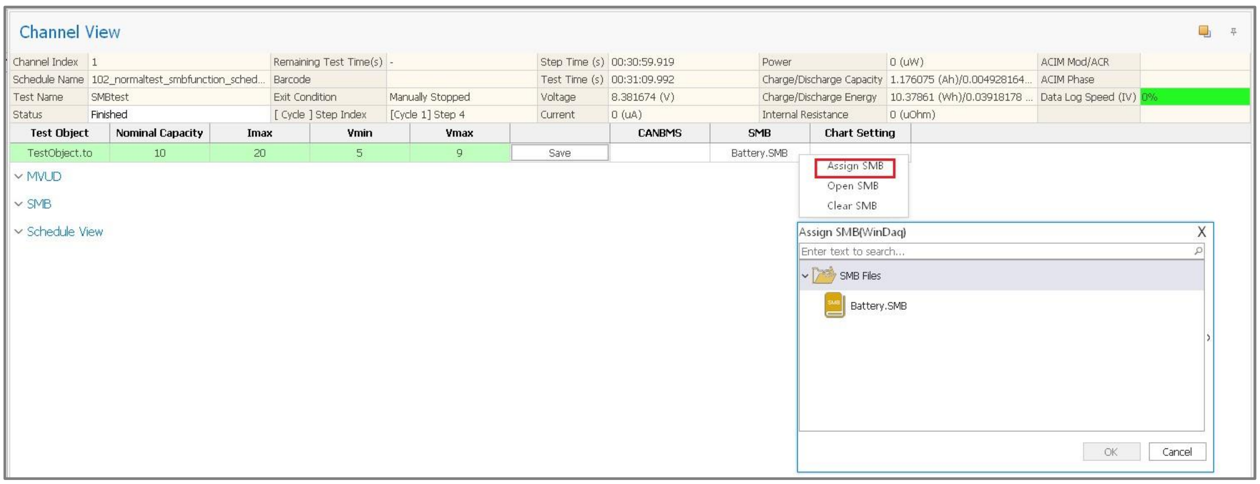


Figure 14-27 Channel View Interface to Load an SMB File

14.5.3 Use SMB in a Schedule

The Schedule in Mits X supports three types of SMB control as shown below.

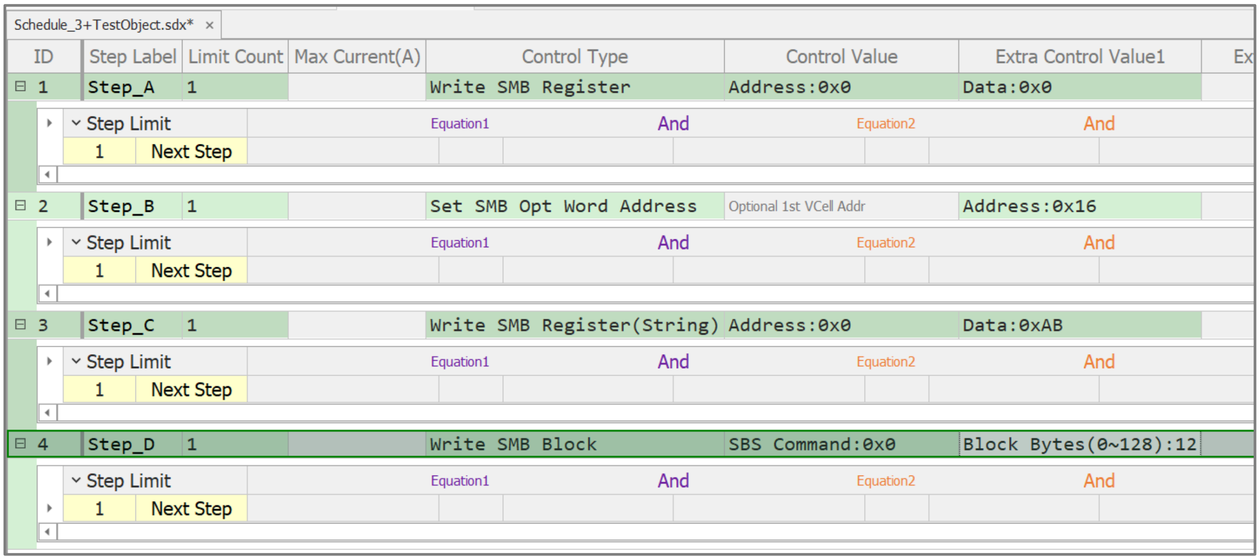


Figure 14-28 Supported SMB Control Types

1) First, the address of the SMB peripheral must be designed (Set SMB Opt Word Address).
2) The next step is to write data or character strings in the corresponding SMB register address (Write SMB Register/Write SMB Register(string)).

Mits X can support SMB block write function: support command + block write functions with a maximum of 128 characters.

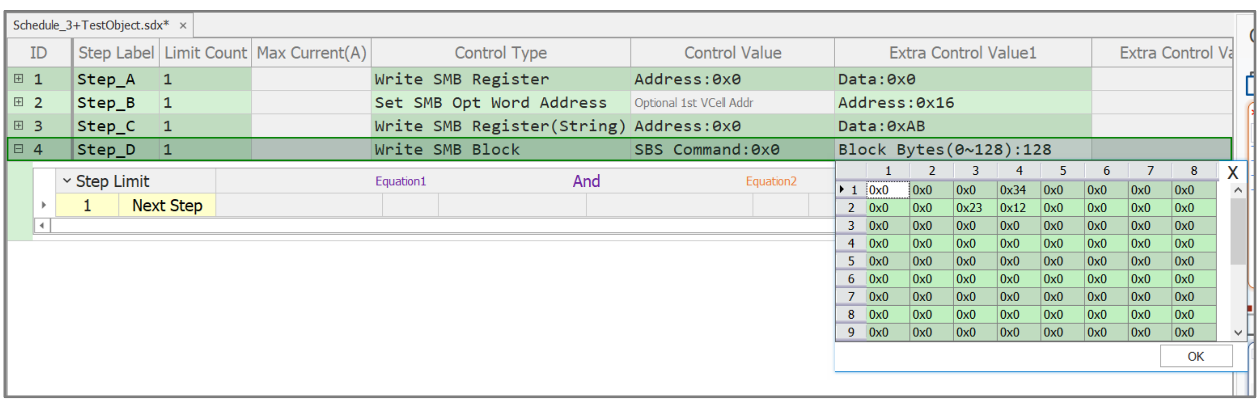


Figure 14-29 SMB Block Write Function

14.6 View the SMB Signal And Data

14.6.1 View the Received CAN BMS Signal

In the "Channel View" of the "Monitor" Interface, the received SMB signal is displayed as shown.

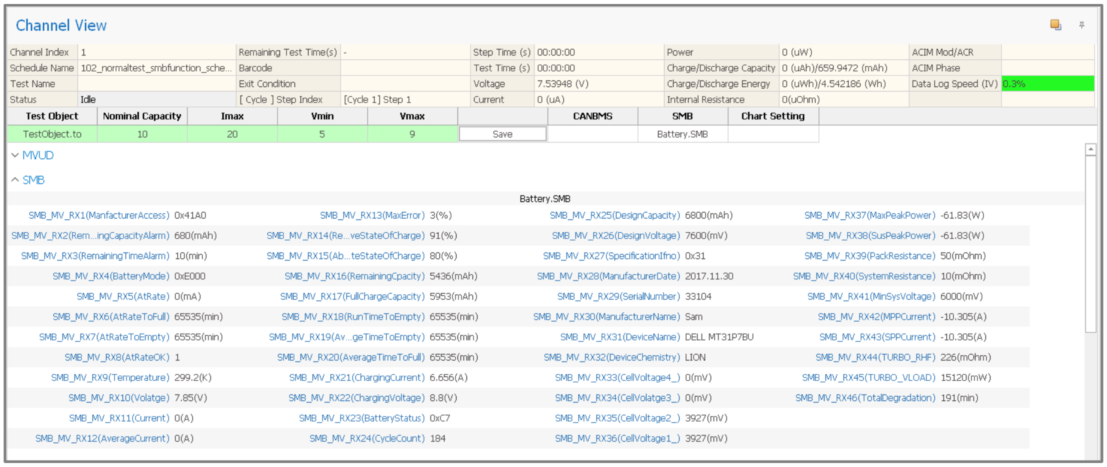


Figure 14-30 SMB Signals in Channel View

14.7.2 Use DataWatcher to View Data.

1) Start the DataWatcher software.
2) Click the “Add Test” or “Data Source” tab header on the DataWatcher homepage.
3) In the “Test Information” Interface that appears, select the test name.
4) Click “Export Test” to open the Export Interface.
5) Click to check the SMB checkmark box and Single sheet box below.
6) Click on the “Export to Files” button to export the SMB information and CAN data table to Excel.

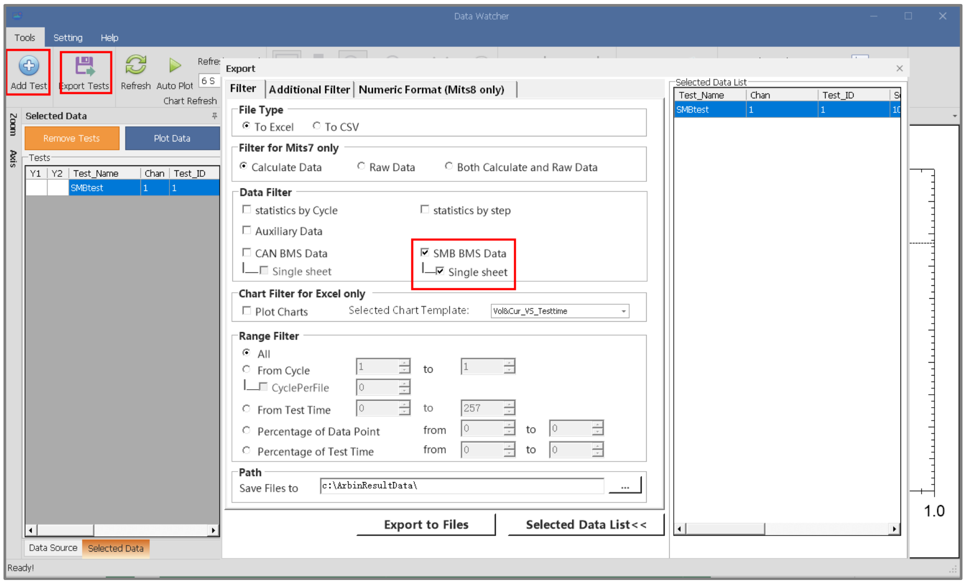
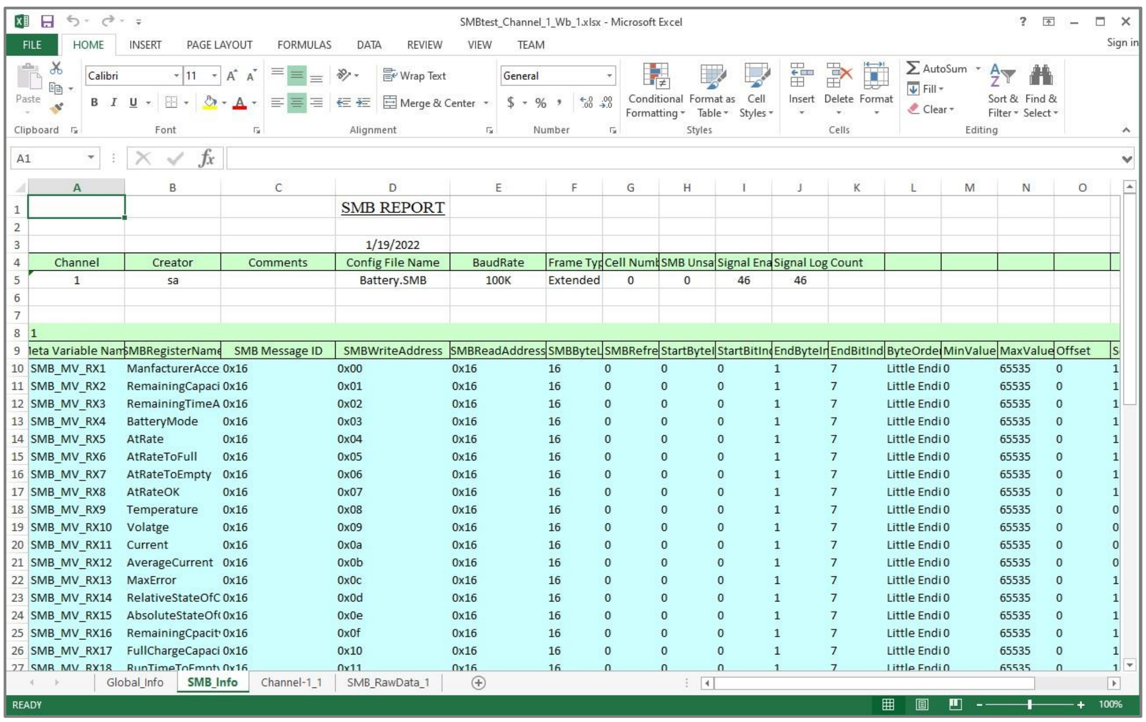


Figure 14-31 Export SMB Data

7) Open the Excel file to view the "SMB Info" and "SMB RawData" tables. The following is SMB_Info. It includes information about enabled SMB signals.



SMBtest_Channel_1_Wb_1.xlsx - Microsoft Excel

SMB REPORT

1/19/2022

Channel	Creator	Comments	Config File Name	BaudRate	Frame Typ	Cell Numb	SMB Unsa	Signal Ena	Signal Log Count
1	sa		Battery.SMB	100K	Extended	0	0	46	46

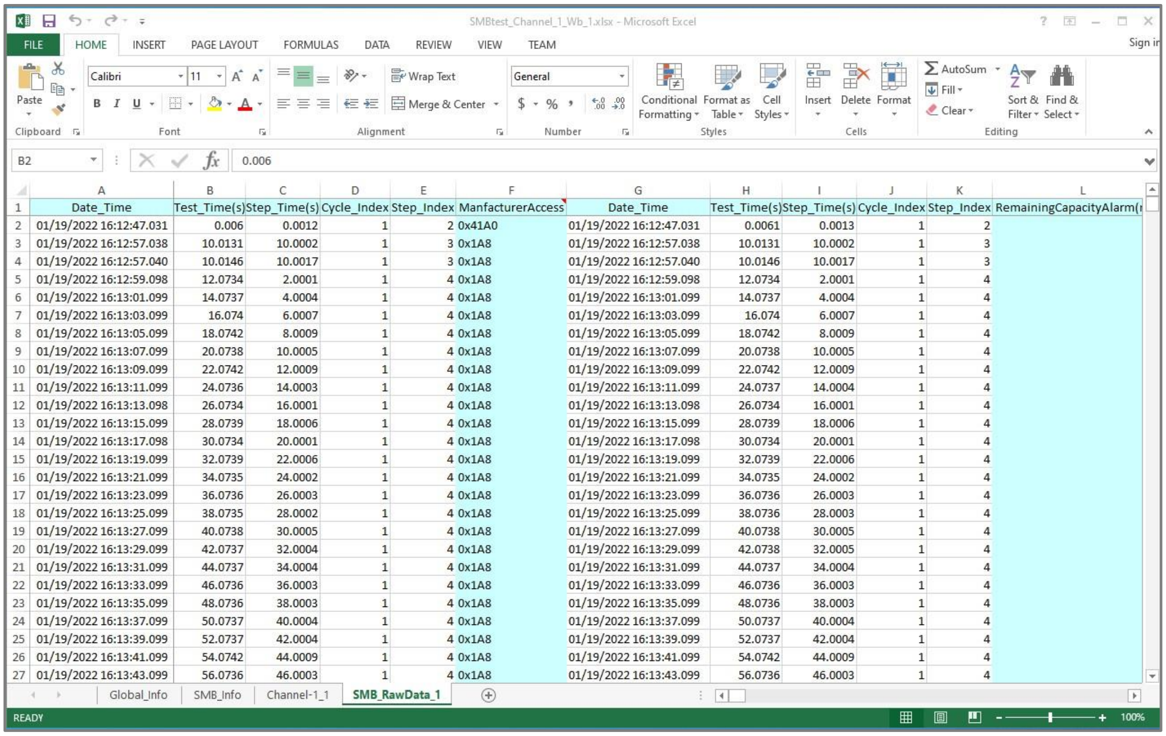
1

leta Variable Nam	SMBRegisterName	SMB Message ID	SMBWriteAddress	SMBReadAddress	SMBByteL	SMBRefre	StartByteI	StartBitIn	EndByteIn	EndBitInd	ByteOrder	MinValue	MaxValue	Offset	S
SMB_MV_RX1	ManfacturerAcce	0x16	0x00	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX2	RemainingCapaci	0x16	0x01	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX3	RemainingTimeA	0x16	0x02	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX4	BatteryMode	0x16	0x03	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX5	AtRate	0x16	0x04	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX6	AtRateToFull	0x16	0x05	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX7	AtRateToEmpty	0x16	0x06	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX8	AtRateOK	0x16	0x07	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX9	Temperature	0x16	0x08	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	0
SMB_MV_RX10	Volatge	0x16	0x09	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	0
SMB_MV_RX11	Current	0x16	0x0a	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	0
SMB_MV_RX12	AverageCurrent	0x16	0x0b	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	0
SMB_MV_RX13	MaxError	0x16	0x0c	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX14	RelativeStateOfC	0x16	0x0d	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX15	AbsoluteStateOf	0x16	0x0e	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX16	RemainingCpacit	0x16	0x0f	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX17	FullChargeCapaci	0x16	0x10	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1
SMB_MV_RX18	RunTimeToEmpt	0x16	0x11	0x16	16	0	0	0	1	7	Little Endi	0	65535	0	1

Global_Info | SMB_Info | Channel-1_1 | SMB_RawData_1

Figure 14-32 SMB Info Table

The following shows SMB_Data.



	Date_Time	Test_Time(s)	Step_Time(s)	Cycle_Index	Step_Index	ManfacturerAccess	Date_Time	Test_Time(s)	Step_Time(s)	Cycle_Index	Step_Index	RemainingCapacityAlarm(
2	01/19/2022 16:12:47.031	0.006	0.0012	1	2	0x41A0	01/19/2022 16:12:47.031	0.0061	0.0013	1	2	
3	01/19/2022 16:12:57.038	10.0131	10.0002	1	3	0x1A8	01/19/2022 16:12:57.038	10.0131	10.0002	1	3	
4	01/19/2022 16:12:57.040	10.0146	10.0017	1	3	0x1A8	01/19/2022 16:12:57.040	10.0146	10.0017	1	3	
5	01/19/2022 16:12:59.098	12.0734	2.0001	1	4	0x1A8	01/19/2022 16:12:59.098	12.0734	2.0001	1	4	
6	01/19/2022 16:13:01.099	14.0737	4.0004	1	4	0x1A8	01/19/2022 16:13:01.099	14.0737	4.0004	1	4	
7	01/19/2022 16:13:03.099	16.074	6.0007	1	4	0x1A8	01/19/2022 16:13:03.099	16.074	6.0007	1	4	
8	01/19/2022 16:13:05.099	18.0742	8.0009	1	4	0x1A8	01/19/2022 16:13:05.099	18.0742	8.0009	1	4	
9	01/19/2022 16:13:07.099	20.0738	10.0005	1	4	0x1A8	01/19/2022 16:13:07.099	20.0738	10.0005	1	4	
10	01/19/2022 16:13:09.099	22.0742	12.0009	1	4	0x1A8	01/19/2022 16:13:09.099	22.0742	12.0009	1	4	
11	01/19/2022 16:13:11.099	24.0736	14.0003	1	4	0x1A8	01/19/2022 16:13:11.099	24.0737	14.0004	1	4	
12	01/19/2022 16:13:13.098	26.0734	16.0001	1	4	0x1A8	01/19/2022 16:13:13.098	26.0734	16.0001	1	4	
13	01/19/2022 16:13:15.099	28.0739	18.0006	1	4	0x1A8	01/19/2022 16:13:15.099	28.0739	18.0006	1	4	
14	01/19/2022 16:13:17.098	30.0734	20.0001	1	4	0x1A8	01/19/2022 16:13:17.098	30.0734	20.0001	1	4	
15	01/19/2022 16:13:19.099	32.0739	22.0006	1	4	0x1A8	01/19/2022 16:13:19.099	32.0739	22.0006	1	4	
16	01/19/2022 16:13:21.099	34.0735	24.0002	1	4	0x1A8	01/19/2022 16:13:21.099	34.0735	24.0002	1	4	
17	01/19/2022 16:13:23.099	36.0736	26.0003	1	4	0x1A8	01/19/2022 16:13:23.099	36.0736	26.0003	1	4	
18	01/19/2022 16:13:25.099	38.0735	28.0002	1	4	0x1A8	01/19/2022 16:13:25.099	38.0736	28.0003	1	4	
19	01/19/2022 16:13:27.099	40.0738	30.0005	1	4	0x1A8	01/19/2022 16:13:27.099	40.0738	30.0005	1	4	
20	01/19/2022 16:13:29.099	42.0737	32.0004	1	4	0x1A8	01/19/2022 16:13:29.099	42.0738	32.0005	1	4	
21	01/19/2022 16:13:31.099	44.0737	34.0004	1	4	0x1A8	01/19/2022 16:13:31.099	44.0737	34.0004	1	4	
22	01/19/2022 16:13:33.099	46.0736	36.0003	1	4	0x1A8	01/19/2022 16:13:33.099	46.0736	36.0003	1	4	
23	01/19/2022 16:13:35.099	48.0736	38.0003	1	4	0x1A8	01/19/2022 16:13:35.099	48.0736	38.0003	1	4	
24	01/19/2022 16:13:37.099	50.0737	40.0004	1	4	0x1A8	01/19/2022 16:13:37.099	50.0737	40.0004	1	4	
25	01/19/2022 16:13:39.099	52.0737	42.0004	1	4	0x1A8	01/19/2022 16:13:39.099	52.0737	42.0004	1	4	
26	01/19/2022 16:13:41.099	54.0742	44.0009	1	4	0x1A8	01/19/2022 16:13:41.099	54.0742	44.0009	1	4	
27	01/19/2022 16:13:43.099	56.0736	46.0003	1	4	0x1A8	01/19/2022 16:13:43.099	56.0736	46.0003	1	4	

Figure 14-33 SMB Data Table

15: Auxiliary Management System Function

15.1 Auxiliary Temperature

15.1.1 What is Auxiliary Temperature?

The auxiliary temperature can collect the temperature of the test object and protect the test object by setting the safety value. To be used, auxiliary temperature needs to be configured in the Config files, Mapping files, and Schedule files.

The number of auxiliary channels used in the Schedule file cannot be greater than the number of auxiliary channels configured in the Mapping file. Likewise, the number of auxiliary channels configured in the Mapping file cannot be greater than the number of auxiliary channels configured in the Config file.

15.1.2 Configure Auxiliary Temperature in a Config File

You can view the configured auxiliary temperature information on the Unit page and the Global page of the Config file.

1) On the Unit page, the Temperature Channel Count is filled with the number of auxiliary Temperature channels (considering the maximum number of channels supported by the auxiliary board, the number of configurations should not exceed the maximum range).

2) The IP address of the Unit is set according to the dial code of the auxiliary board.
3) The Aux Temperature column configures the total number of all secondary channels on the secondary Unit board.

NOTE: The manufacturer has set the configuration of this file before leaving the factory. If you need to change it, please contact the Arbin Customer Support.

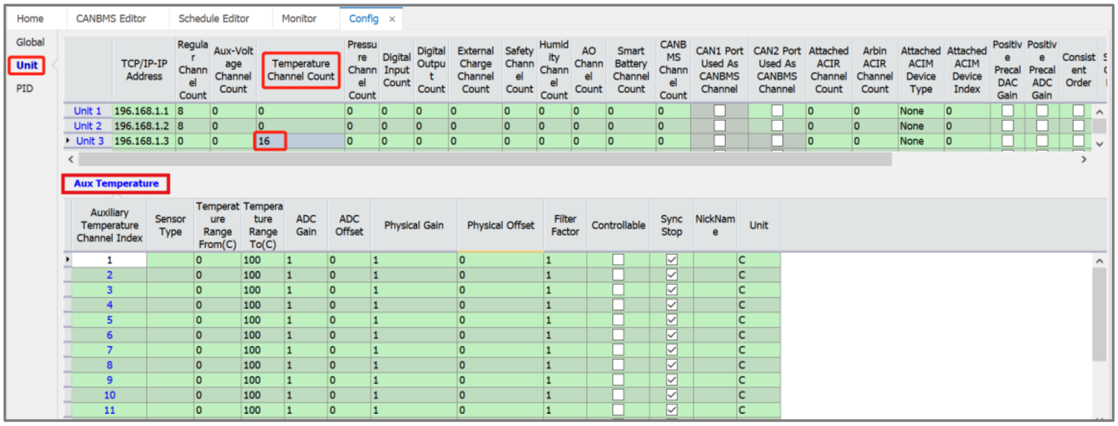


Figure 15-1 Display the Configuration on the Unit Page

4) On the Global page, the number of configured auxiliary temperature channels will be displayed in the column of auxiliary temperature.

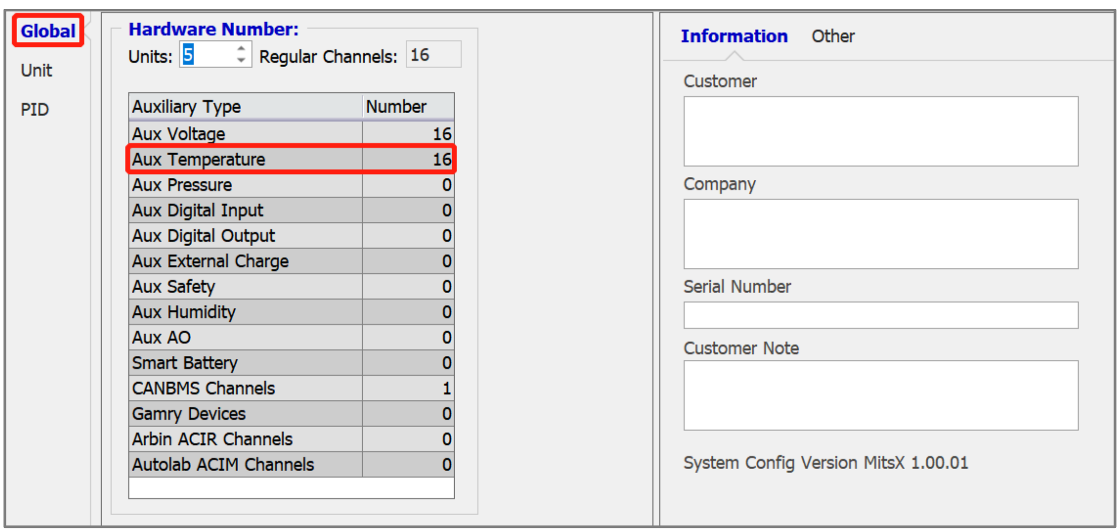


Figure 15-2 Display the Configuration on the Global Page

15.1.3 Configure Auxiliary in a Mapping File

If you need to use the auxiliary during tests, you must configure it in the Mapping file first. After the configuration, the temperature information will be displayed on the Monitor page. For the specific configuration methods, please refer to **Chapter 7: Mapping Files**. After a successful deployment, you can see the configuration information on the Mapping page as in Figure 15-3.

Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
2					10	5	50		
	Aux Voltage	1	1	Public				4	1
	Aux Voltage	2	2	Public				4	2
	Aux Temperature	1	1	Public				3	1
3					10	5	50		
	Aux Voltage	1	1	Public				4	1
4					10	5	50		
5					10	5	50		
6					10	5	50		
Chan 7(7 to 8)					20	5	100		
	Aux Voltage	1	1	Public				4	1
	Aux Temperature	1	1	Public				3	1
9					10	5	50		
	Aux Voltage	1	1	Public				4	1
	Aux Voltage	2	2	Public				4	2
	Aux Voltage	3	3	Public				4	3
	Aux Voltage	4	4	Public				4	4
	Aux Temperature	1	1	Public				3	1
	Aux Temperature	2	2	Public				3	2

Figure 15-3 Display Configuration Information on the Mapping Page

15.1.4 Configure Auxiliary Temperature in a Schedule File

The previous two sections introduce configuring the auxiliary information in the Config file and the Mapping file. It is also necessary to configure the auxiliary temperature in the Schedule file before using it. The following content will introduce the configuration of auxiliary temperature in Aux Number and Safety.

Configure the Number of Auxiliary Temperature Channels

The number of auxiliary temperature channels can be configured when creating a new Schedule File, as shown in Figure 15-4. It can also be configured in the Auxiliary Temperature part of Aux Number and Safety on the Global Page of an existing Schedule File, as shown in Figure 15-5.

NOTE: The value entered here cannot exceed the number of auxiliary temperature channels configured in the Mapping File.

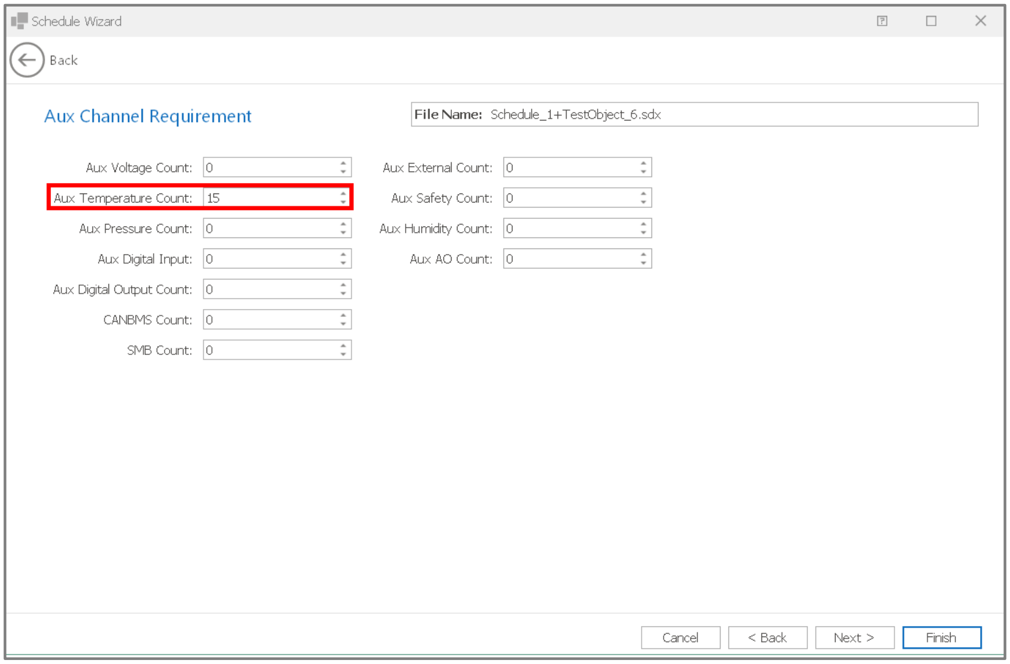


Figure 15-4 Configure the Auxiliary Temperature when Creating a New Schedule

Set the Auxiliary Temperature Safety Value

After configuring the number of auxiliary temperature channels, there will be a safety option to configure the maximum and minimum auxiliary temperature.

1) Fill in the minimum value of the auxiliary temperature in the input box under Item Low.
2) Fill in the minimum value of the auxiliary temperature in the input box under Item High.

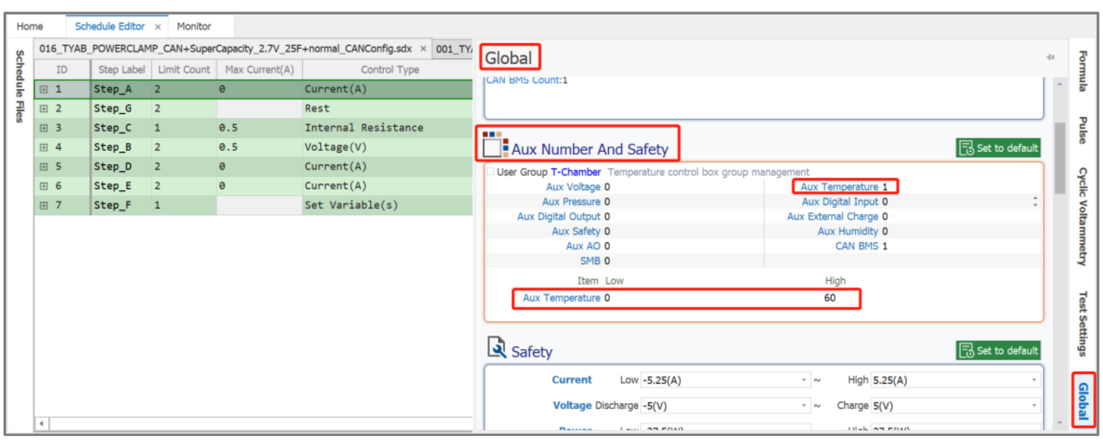


Figure 15-5 Configure Auxiliary Temperature in Schedule

15.1.5 Apply Auxiliary Temperature

The auxiliary temperature can be used in Formulas, Step Control values, and Limit Variable values. The content below introduces its application methods one by one.

Apply Auxiliary Temperature in the Formula Page

1) Create a new Formula.
   a) Right-click in the blank space of the Formula page.
   b) Click on the "Append Formula" option that appears to create a new Formula named "F_A."

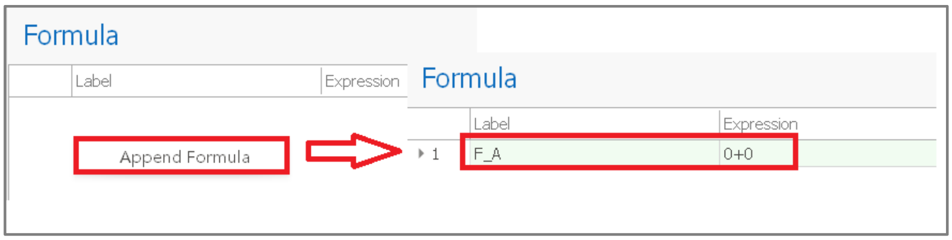


Figure 15-6 Add a New Formula

2) Left-click the Expression input box of the formula to open the customization Interface.
3) In the customization Interface, right-click the input box of the input field where the Meta Variable should be added (For example, X1).
4) Click on the Meta Variable option in the menu that appears.
5) Select the auxiliary temperature AV_T in the Auxiliary Value of the "Meta Variable" Interface.

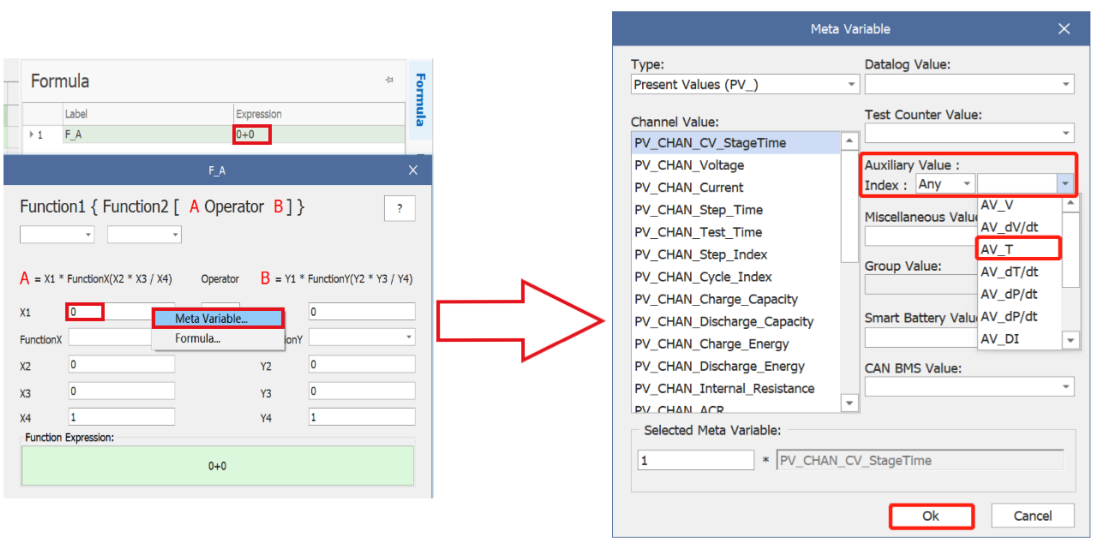


Figure 15-7 Configure Auxiliary Temperature in Meta Variable

6) Set the Index Value.
   a) The default Index is Any.
   b) You can customize the Index Value to a specific channel number (1, 2, 3, etc.).

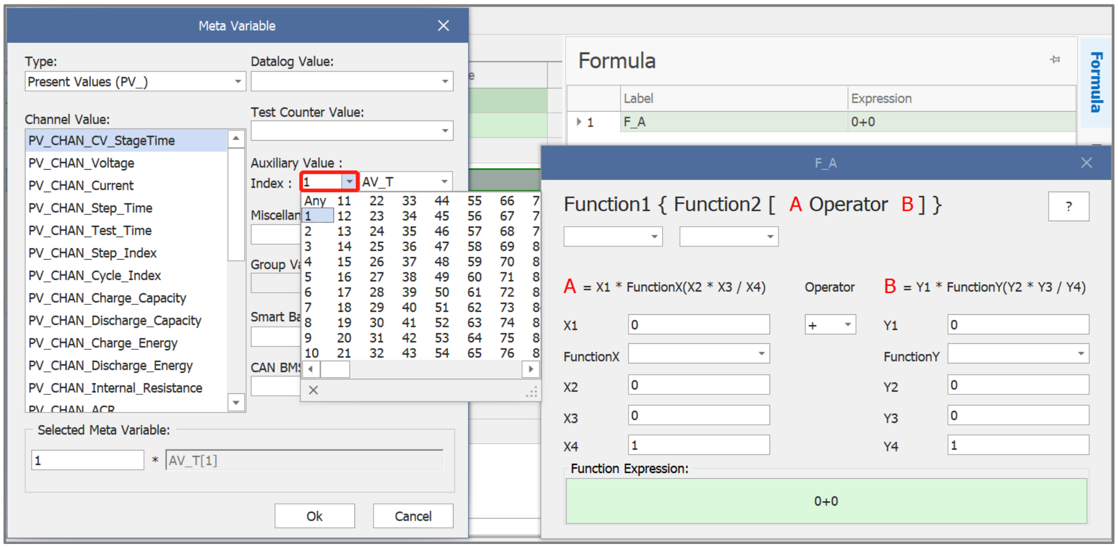


Figure 15-8 Select the Channel Number in Meta Variable

7) Click the “OK’ button at the bottom of the “Meta Variable” Interface to save the changes.

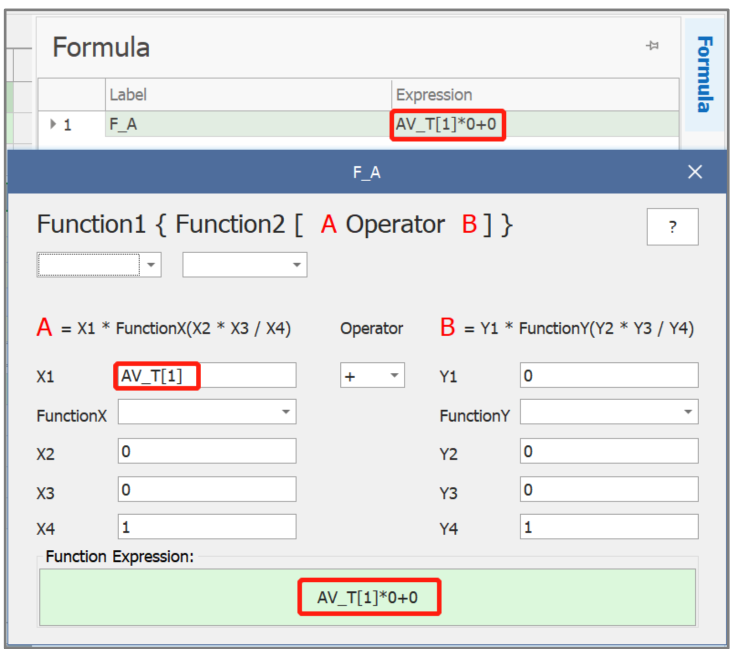


Figure 15-9 Auxiliary Temperature Applied in the Formula Page

Apply Auxiliary Temperature in a Step/Limit

The auxiliary temperature can be used as a variable and a formula applied to the control value of Step and the variable value of Limit.

As a variable, the application steps are as follows:

1) Right-click the control value of the Step.
2) Click on the “Meta Variable” option in the menu that appears.
3) Click on the “More…” option in the drop-down menu to open the “Meta Variable” Interface.

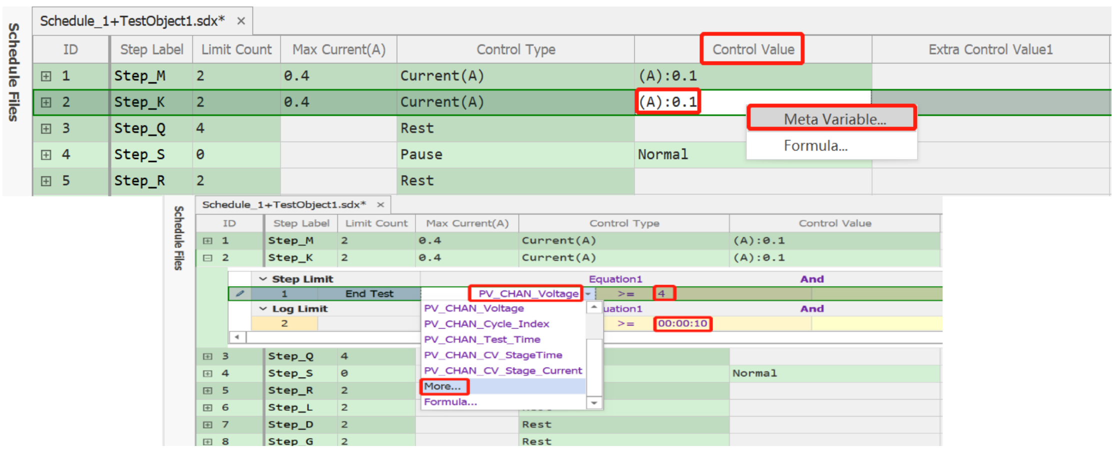


Figure 15-10 Open the Meta Variable Interface

4) Configure the auxiliary temperature in the Auxiliary Value on the “Meta Variable” Interface. (**NOTE:** When the auxiliary temperature is used as the control value, Index cannot be Any.)

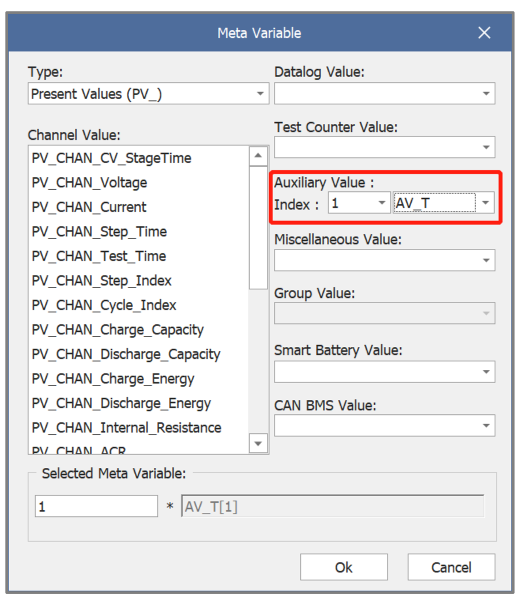


Figure 15-11 Select the Auxiliary Temperature in Meta Variable

5) Click the “OK” button on the “Meta Variable” Interface to successfully apply the variable.

Figure 15-12 shows a Schedule File with a successfully applied variable.

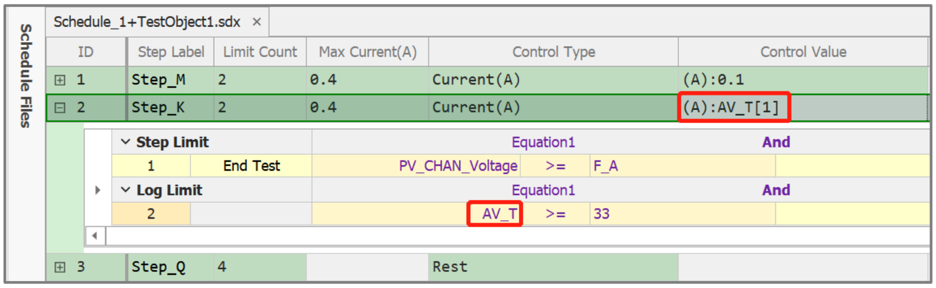


Figure 15-12 Schedule File with Variable Applied

As a formula, the application steps are as follows:

1) Right-click on the control value of the Step/variable value of Limit.
2) Click on the “Formula…” option in the menu that appears to open the “FormulaList” Interface.

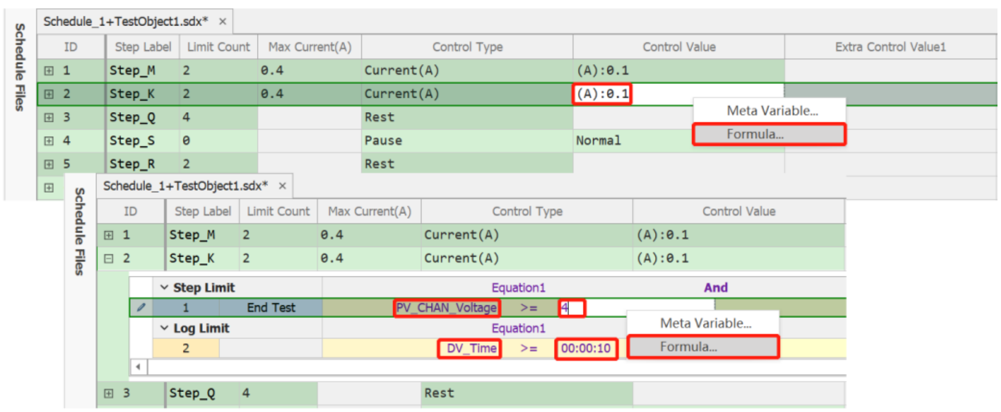


Figure 15-13 Apply Auxiliary Temperature in Formula

3) Select the corresponding formula in the “FormulaList” Interface.

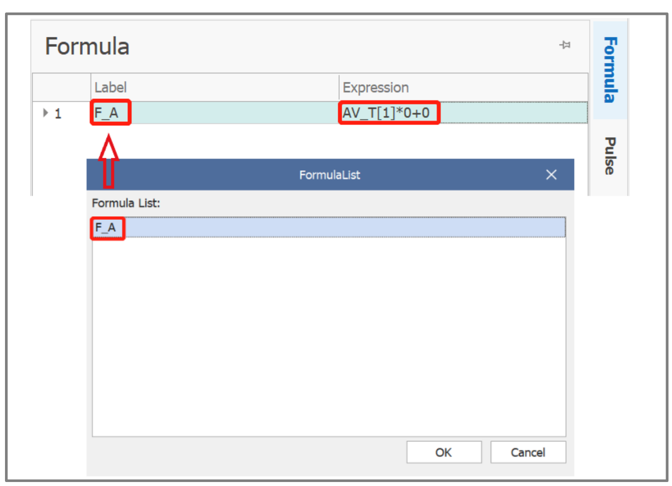


Figure 15-14 Formula Selection

4) Click the “OK” button at the bottom of the “FormulaList” Interface.

Figure 15-15 shows a Schedule File with a successfully applied formula.

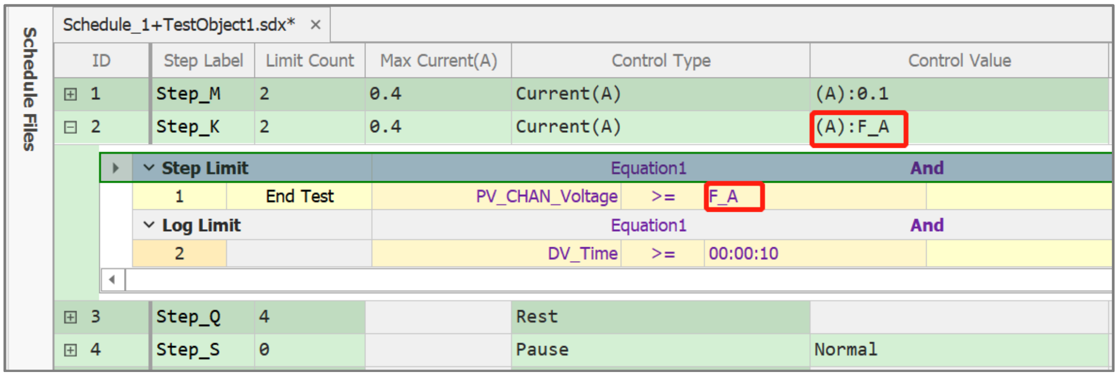


Figure 15-15 Auxiliary Temperature Formula Has Been Applied

15.1.6 View Auxiliary Temperature Data

You can view auxiliary temperature data through DataWatcher or Monitor.

View Auxiliary Temperature Data in DataWatcher

There are 3 ways to view data in DataWatcher: graphs, tables, and Excel files.

1) View auxiliary temperature data in the DataWatcher graph.
   a) Open DataWatcher from the Monitor and Control Interface (select the channel and click the DataWatcher icon) or from the file directory of DataWatcher.

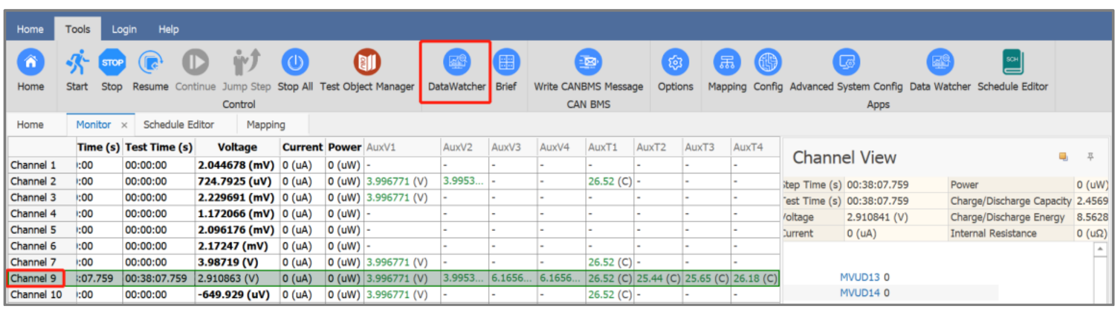


Figure 15-16 Open DataWatcher from Monitor

b) Under the Data Source section in DataWatcher, select the test file.
c) Click “Add to Selected” to add the test file to the data you want to display.
d) Click the “Plot Data” to go to the Selected Data page.

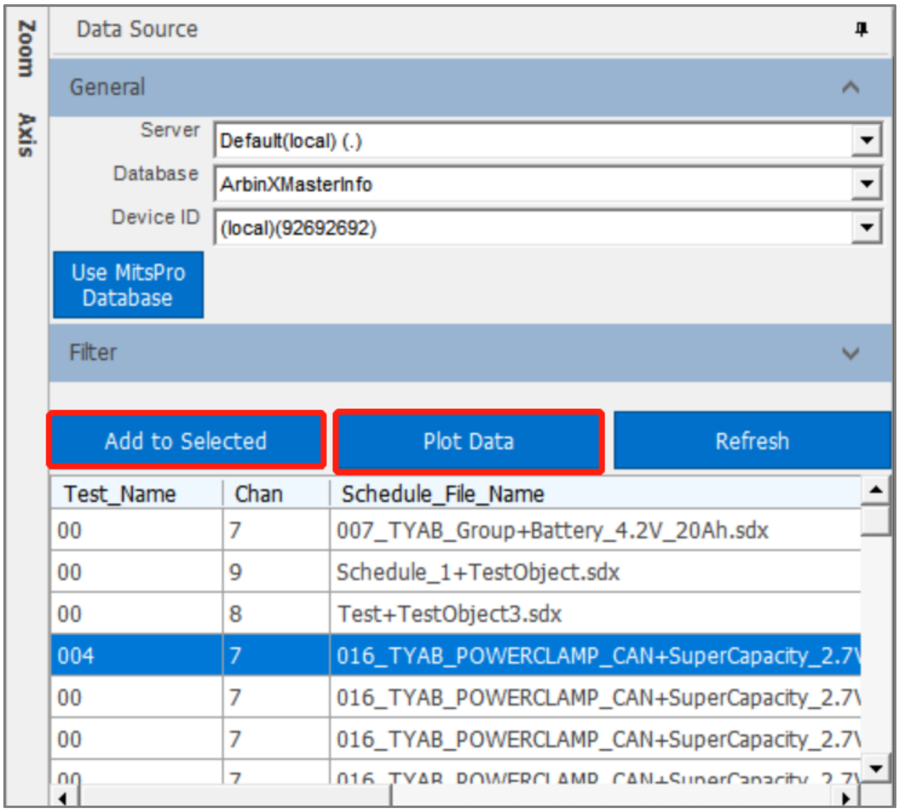


Figure 15-17 Select Data

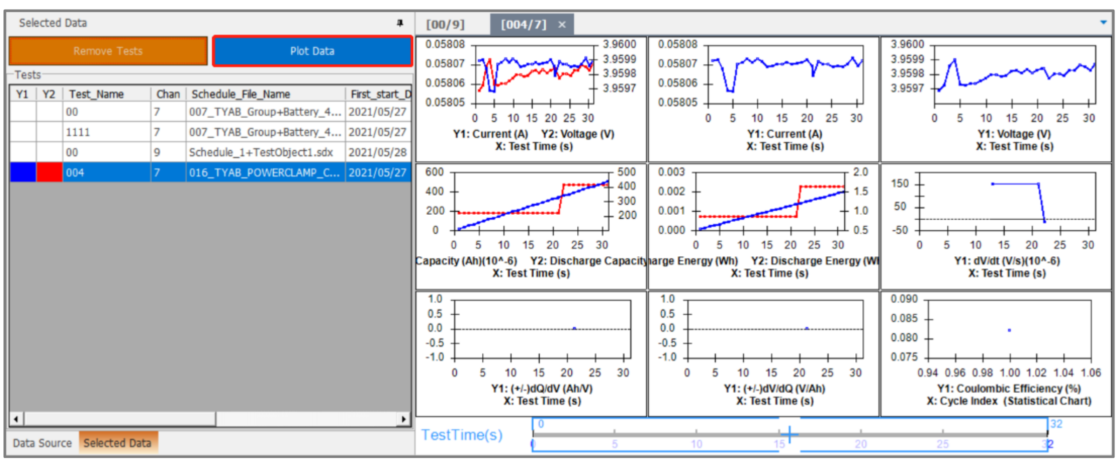


Figure 15-18 Display Data

e) Double on a chart to open a larger view of the selected chart.
f) Click on the “Y1” icon at the top of DataWatcher.
g) Select the auxiliary channel number.
h) Click to select the auxiliary data you want to display from the menu that appears.

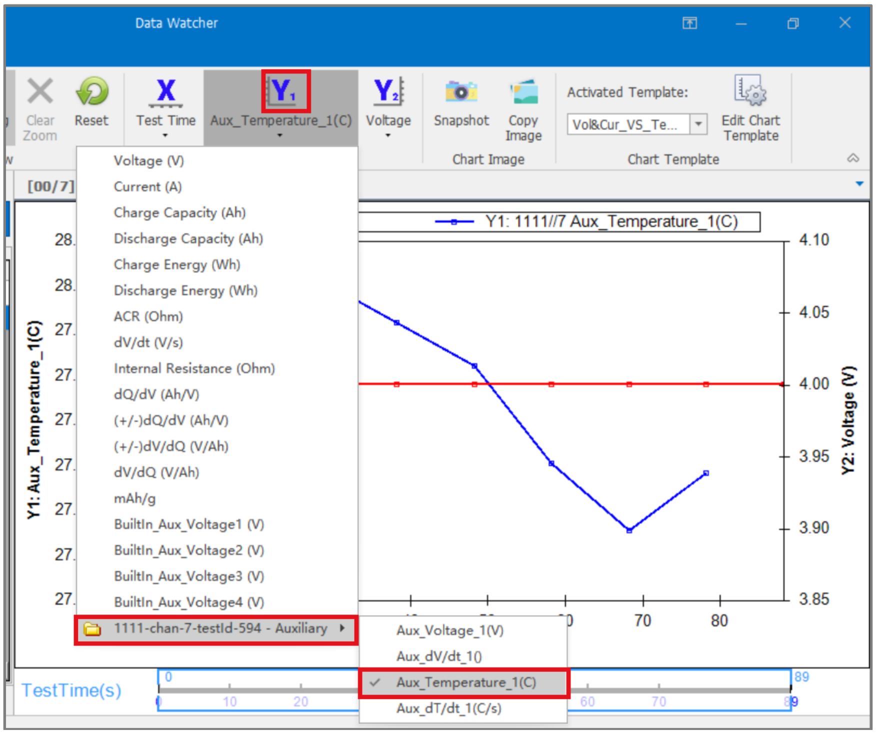


Figure 15-19 View Data with Graphs

2) Display auxiliary data in the tables of DataWatcher
   a) Click on the “Show Data” button in the figure to open the data table and view the data.

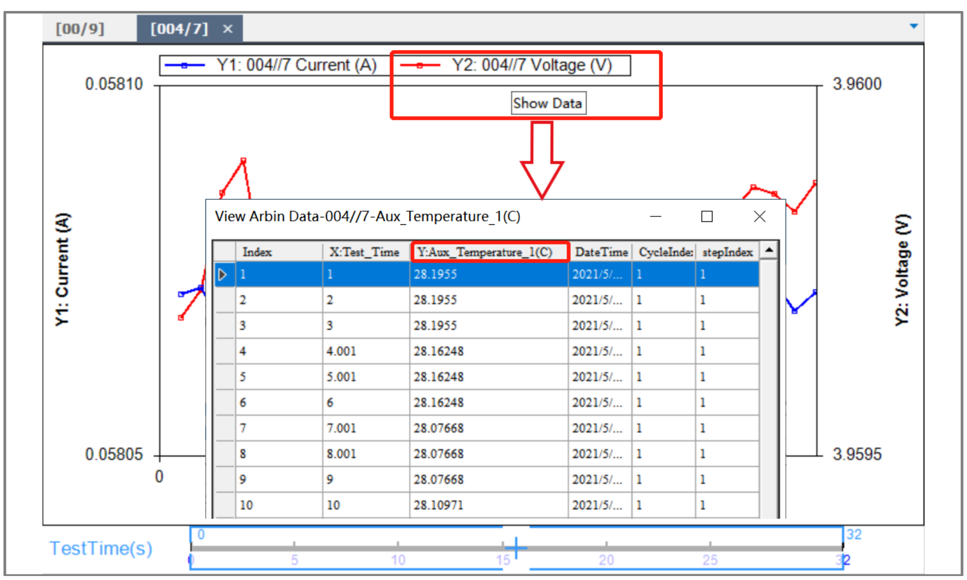


Figure 15-20 View Data with Tables

3) View auxiliary data in an Excel or CSV file.
   a) Click on the "Export Test" icon in the toolbar to open the "Export" Interface.
   b) Under "File Type," select either "To Excel" or "To CSV" based on the file type you want to export.
   c) Under the "Data Filter" section of the "Export" Interface, click the checkmark box to select "Auxiliary Data."
   d) Click on the "Export to Files" button at the bottom of the "Export" Interface to export the data.

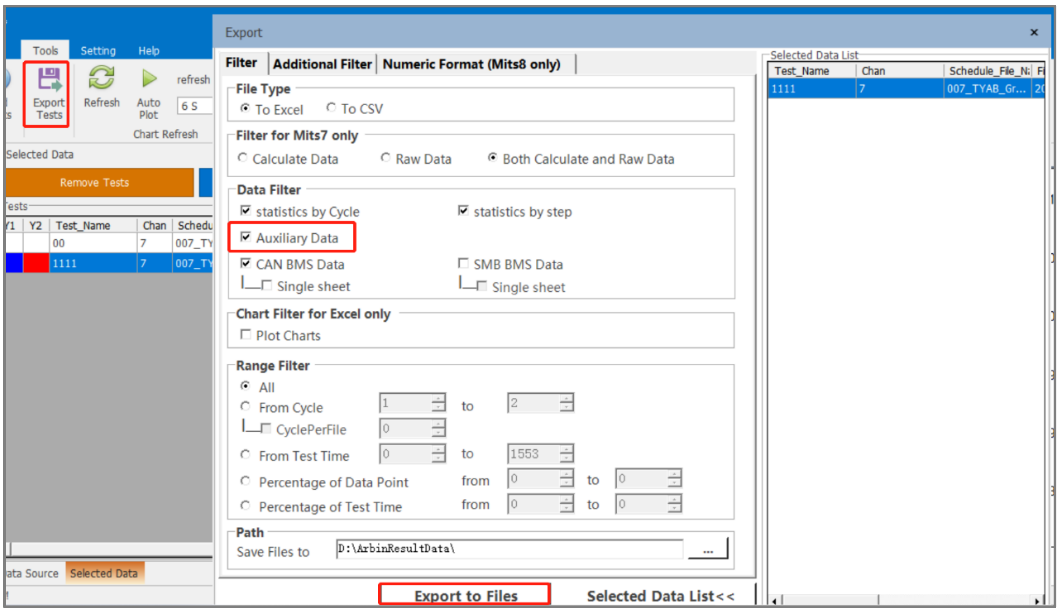


Figure 15-21 Export Excel Data

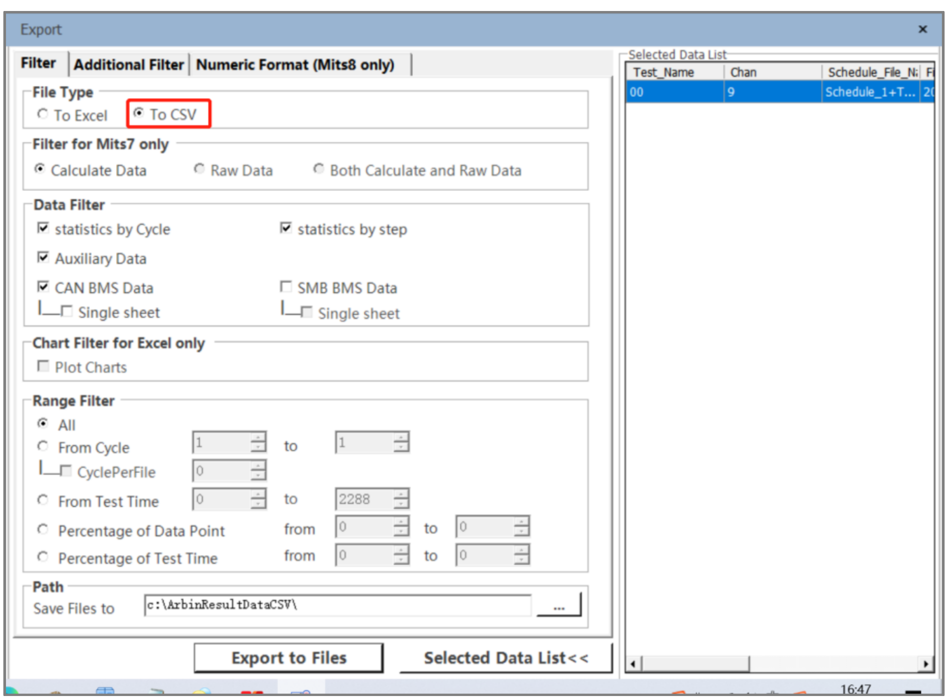


Figure 15-22 Export CSV Data

e) Select the file and click Open.

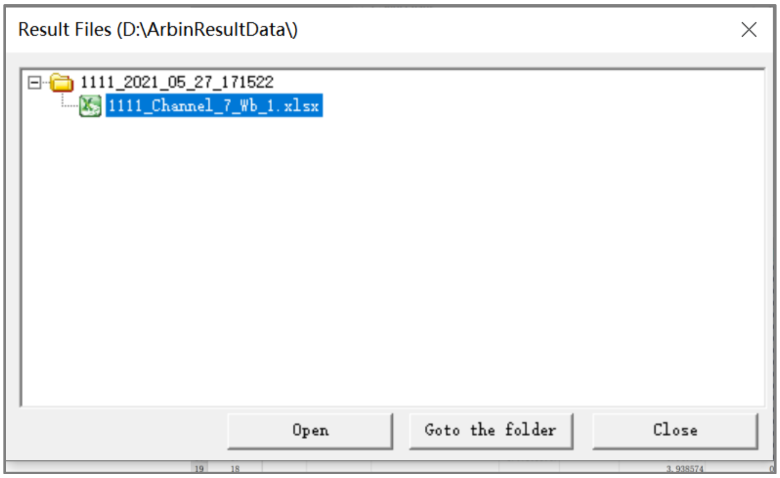


Figure 15-23 Open Excel Data

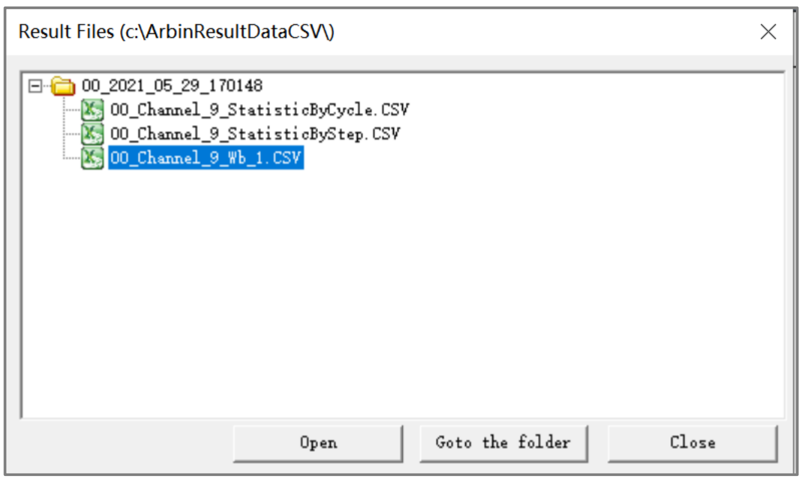
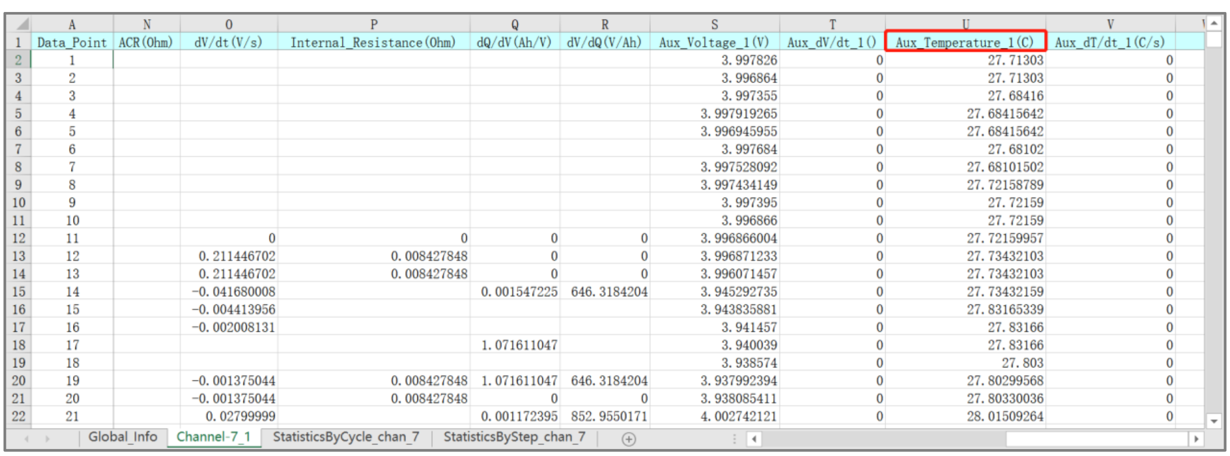


Figure 15-24 Open CSV Data

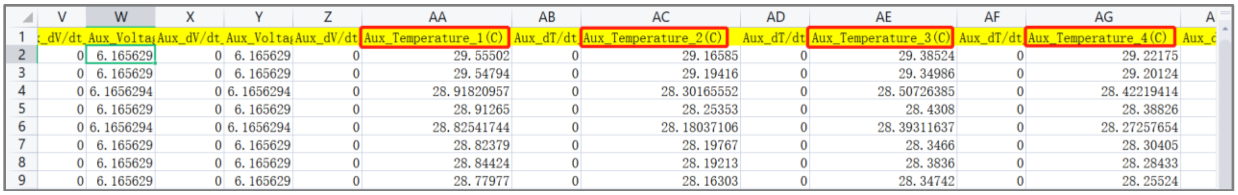
f) You will then be able to view the data in Excel in your chosen file format.



	A	N	O	P	Q	R	S	T	U	V
1	Data_Point	ACR(Ohm)	dV/dt(V/s)	Internal_Resistance(Ohm)	dQ/dV(Ah/V)	dV/dQ(V/Ah)	Aux_Voltage_1(V)	Aux_dV/dt_1()	Aux_Temperature_1(C)	Aux_dT/dt_1(C/s)
2	1						3.997826	0	27.71303	0
3	2						3.996864	0	27.71303	0
4	3						3.997355	0	27.68416	0
5	4						3.997919265	0	27.68415642	0
6	5						3.996945955	0	27.68415642	0
7	6						3.997684	0	27.68102	0
8	7						3.997528092	0	27.68101502	0
9	8						3.997434149	0	27.72158789	0
10	9						3.997395	0	27.72159	0
11	10						3.996866	0	27.72159	0
12	11		0	0	0	0	3.996866004	0	27.72159957	0
13	12		0.211446702	0.008427848	0	0	3.996871233	0	27.73432103	0
14	13		0.211446702	0.008427848	0	0	3.996071457	0	27.73432103	0
15	14		-0.041680008		0.001547225	646.3184204	3.945292735	0	27.73432159	0
16	15		-0.004413956				3.943835881	0	27.83165339	0
17	16		-0.002008131				3.941457	0	27.83166	0
18	17				1.071611047		3.940039	0	27.83166	0
19	18						3.938574	0	27.803	0
20	19		-0.001375044	0.008427848	1.071611047	646.3184204	3.937992394	0	27.80299568	0
21	20		-0.001375044	0.008427848	0	0	3.938085411	0	27.80330036	0
22	21		0.02799999		0.001172395	852.9550171	4.002742121	0	28.01509264	0

Global_Info | Channel-7_1 | StatisticsByCycle_chan_7 | StatisticsByStep_chan_7

Figure 15-25 View Excel Data

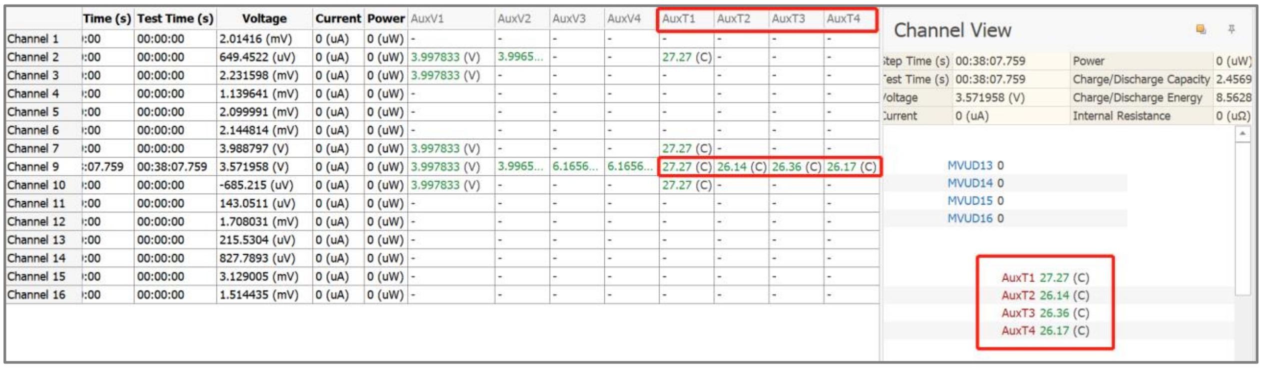


	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	A
1	_dV/dt_	Aux_Volta	Aux_dV/dt_	Aux_Volta	Aux_dV/dt	Aux_Temperature_1(C)	Aux_dT/dt_	Aux_Temperature_2(C)	Aux_dT/dt	Aux_Temperature_3(C)	Aux_dT/dt	Aux_Temperature_4(C)	Aux_c
2	0	6.165629	0	6.165629	0	29.55502	0	29.16585	0	29.38524	0	29.22175	
3	0	6.165629	0	6.165629	0	29.54794	0	29.19416	0	29.34986	0	29.20124	
4	0	6.1656294	0	6.1656294	0	28.91820957	0	28.30165552	0	28.50726385	0	28.42219414	
5	0	6.165629	0	6.165629	0	28.91265	0	28.25353	0	28.4308	0	28.38826	
6	0	6.1656294	0	6.1656294	0	28.82541744	0	28.18037106	0	28.39311637	0	28.27257654	
7	0	6.165629	0	6.165629	0	28.82379	0	28.19767	0	28.3466	0	28.30405	
8	0	6.165629	0	6.165629	0	28.84424	0	28.19213	0	28.3836	0	28.28433	
9	0	6.165629	0	6.165629	0	28.77977	0	28.16303	0	28.34742	0	28.25524	

Figure 15-26 View CSV Data

View Auxiliary Temperature Data in Monitor

1) Open the Monitor and view it in the main page (Detail View/Brief View) or Channel View Interface.



	Time (s)	Test Time (s)	Voltage	Current	Power	AuxV1	AuxV2	AuxV3	AuxV4	AuxT1	AuxT2	AuxT3	AuxT4
Channel 1	:00	00:00:00	2.01416 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 2	:00	00:00:00	649.4522 (uV)	0 (uA)	0 (uW)	3.997833 (V)	3.9965...	-	-	27.27 (C)	-	-	-
Channel 3	:00	00:00:00	2.231598 (mV)	0 (uA)	0 (uW)	3.997833 (V)	-	-	-	-	-	-	-
Channel 4	:00	00:00:00	1.139641 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 5	:00	00:00:00	2.099991 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 6	:00	00:00:00	2.144814 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 7	:00	00:00:00	3.988797 (V)	0 (uA)	0 (uW)	3.997833 (V)	-	-	-	27.27 (C)	-	-	-
Channel 9	:07.759	00:38:07.759	3.571958 (V)	0 (uA)	0 (uW)	3.997833 (V)	3.9965...	6.1656...	6.1656...	27.27 (C)	26.14 (C)	26.36 (C)	26.17 (C)
Channel 10	:00	00:00:00	-685.215 (uV)	0 (uA)	0 (uW)	3.997833 (V)	-	-	-	27.27 (C)	-	-	-
Channel 11	:00	00:00:00	143.0511 (uV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 12	:00	00:00:00	1.708031 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 13	:00	00:00:00	215.5304 (uV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 14	:00	00:00:00	827.7893 (uV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 15	:00	00:00:00	3.129005 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-
Channel 16	:00	00:00:00	1.514435 (mV)	0 (uA)	0 (uW)	-	-	-	-	-	-	-	-

Figure 15-27 View Data in Monitor

15.2 Auxiliary Voltage

15.2.1 What is Auxiliary Voltage?

The auxiliary voltage can collect the temperature of the test object and protect it by setting a safety value. To be used, auxiliary voltage needs to be configured in the Config, Mapping, and Schedule files.

The relationship of the number of auxiliary voltage channels, which are configured in the Config, Mapping, and Schedule files is: Config >= Mapping >= Schedule. The number of auxiliary channels used in the Schedule file cannot be greater than the number of auxiliary channels configured in the Mapping file. The number of auxiliary channels configured in the Mapping file cannot be greater than the number of auxiliary channels configured in the Config file.

15.2.2 Configure Auxiliary Voltage in a Config File

You can view the configured auxiliary voltage information on the Unit page and the Global page of the Config file.

1) On the Unit page, the Aux-Voltage Channel Count is filled with the number of auxiliary voltage channels. (Considering the maximum number of channels supported by the auxiliary board, the number of configurations should not exceed the maximum range).
2) The IP address of the Unit is set according to the dial code of the auxiliary board.

3) The Aux Voltage column configures the total number of all secondary channels on the secondary Unit board.

NOTE: The manufacturer has set the configuration of this file before leaving the factory. If you need to change it, please contact the Arbin Customer Support.

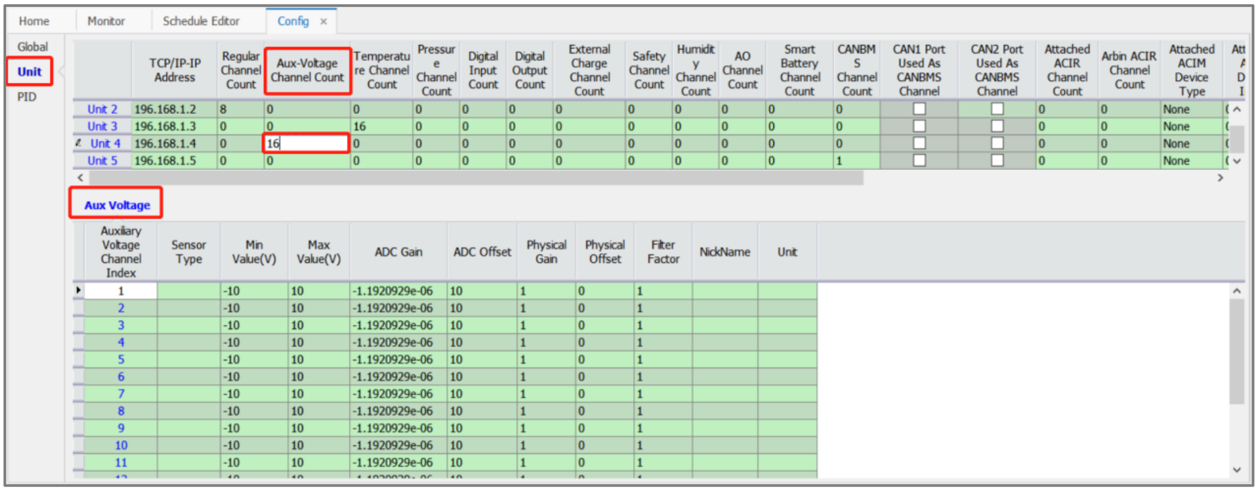


Figure 15-28 Configure Auxiliary Voltage in Config

4) On the Global page, the number of configured auxiliary voltage channels will be displayed in the column of auxiliary voltage.

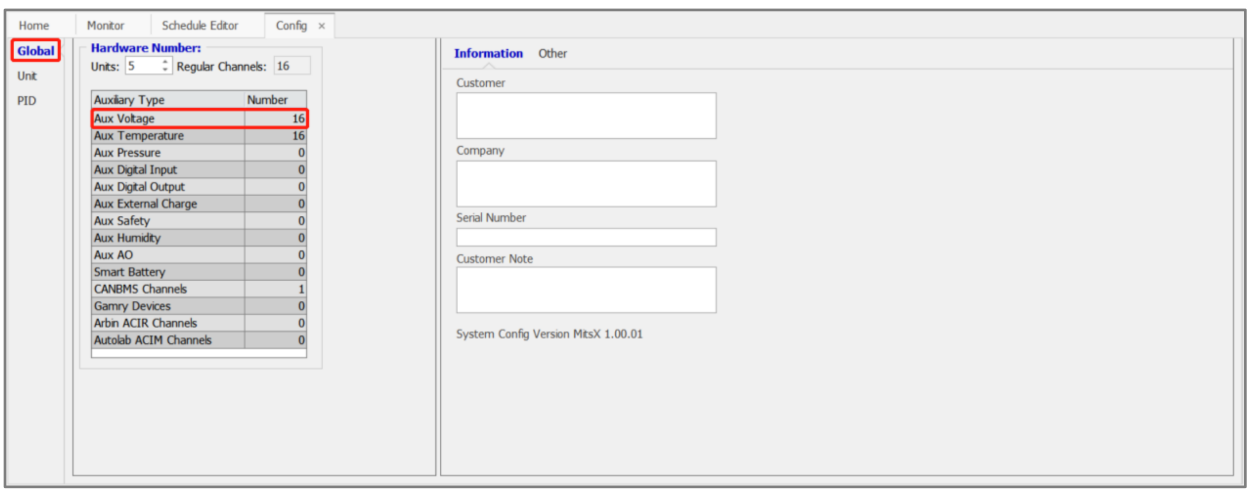
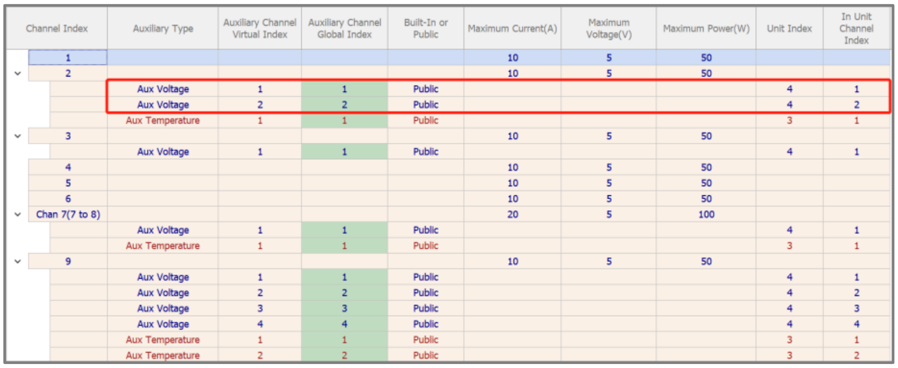


Figure 15-29 Auxiliary Voltage Channels Displayed on Global Page

15.2.3 Configure Auxiliary Voltage in a Mapping File

If you need to use the auxiliary during the test, you must configure it in the Mapping file first. After the configuration, the auxiliary voltage information will be displayed on the Monitor page. For the specific configuration methods, please refer to **Chapter 7: Mapping Files**. After successful configuration, you can see the configuration information on the following page.



Channel Index	Auxiliary Type	Auxiliary Channel Virtual Index	Auxiliary Channel Global Index	Built-In or Public	Maximum Current(A)	Maximum Voltage(V)	Maximum Power(W)	Unit Index	In Unit Channel Index
1					10	5	50		
2					10	5	50		
	Aux Voltage	1	1	Public				4	1
	Aux Voltage	2	2	Public				4	2
	Aux Temperature	1	1	Public				3	1
3					10	5	50		
	Aux Voltage	1	1	Public				4	1
4					10	5	50		
5					10	5	50		
6					10	5	50		
Chan 7(7 to 8)					20	5	100		
	Aux Voltage	1	1	Public				4	1
	Aux Temperature	1	1	Public				3	1
9					10	5	50		
	Aux Voltage	1	1	Public				4	1
	Aux Voltage	2	2	Public				4	2
	Aux Voltage	3	3	Public				4	3
	Aux Voltage	4	4	Public				4	4
	Aux Temperature	1	1	Public				3	1
	Aux Temperature	2	2	Public				3	2

Figure 15-30 Display Configuration Information on the Mapping Page

15.2.4 Configure Auxiliary Voltage in a Schedule File

The previous two sections introduce the configure the auxiliary information in the Config file and the Mapping file. It is also necessary to configure the auxiliary voltage in the Schedule file before it can be used. The following will introduce the configuration of auxiliary voltage in Aux Number and Safety of the Schedule File.

Configure the Number of Auxiliary Voltage Channels

The number of auxiliary temperature channels can be configured when creating a new Schedule File, as shown in Figure 15-31. It can also be configured in the Auxiliary Temperature part of Aux Number and Safety on the Global Page of an existing Schedule File, as shown in Figure 15-32.

NOTE: The value entered here cannot exceed the number of auxiliary voltage channels configured in the Mapping File.

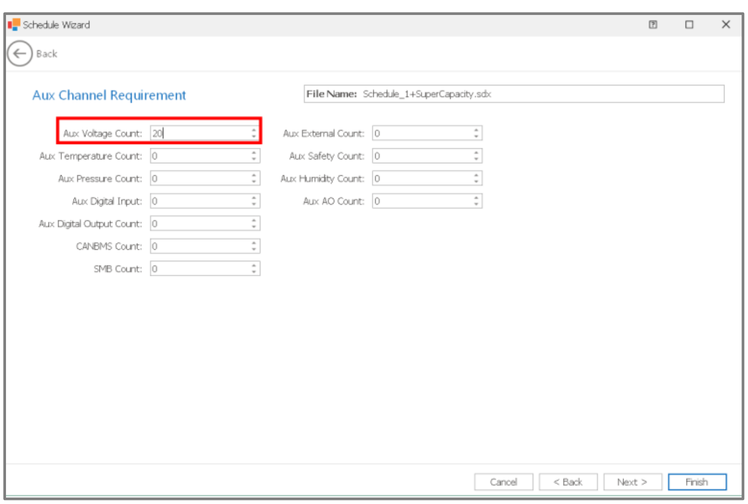


Figure 15-31 Configure the Auxiliary Voltage when Creating a New Schedule

Set the Auxiliary Voltage Safety Value

Set the auxiliary voltage safety value: After configuring the number of auxiliary voltage channels, there will be a safety option to configure the maximum and minimum auxiliary voltage.

1) Fill in the minimum value of the auxiliary voltage in the input box under Item Low.
2) Fill in the maximum value of the auxiliary voltage in the input box under Item High.

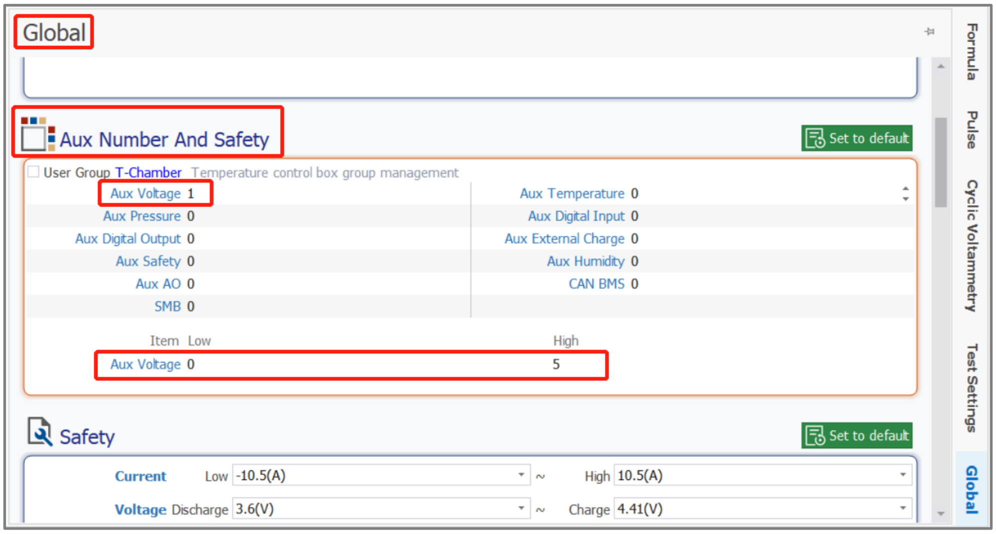


Figure 15-32 Configure Auxiliary Safety Values in Schedule

15.2.5 Apply Auxiliary Voltage

The auxiliary voltage can be used in Formulas, Step Control values, and Limit Variable values. The following will introduce its application methods one by one.

Apply Auxiliary Voltage in the Formula Page

1) Create a new Formula.
   a) Right-click in the blank space of the Formula page.
   b) Click on the “Append Formula” option that appears to create a new Formula named “F_A.”

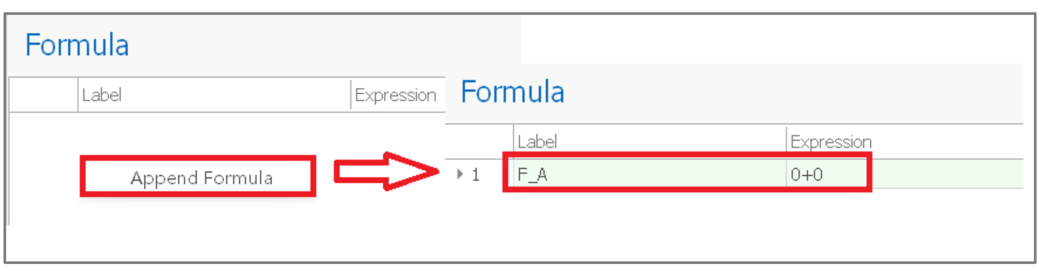


Figure 15-33 Add a New Formula

2) Left-click the Expression input box of the Formula to open the customization Interface.
3) In the customization Interface, right-click the input box of the input field where the Meta Variable should be added (For example, X1).
4) Click on the Meta Variable option in the menu that appears.

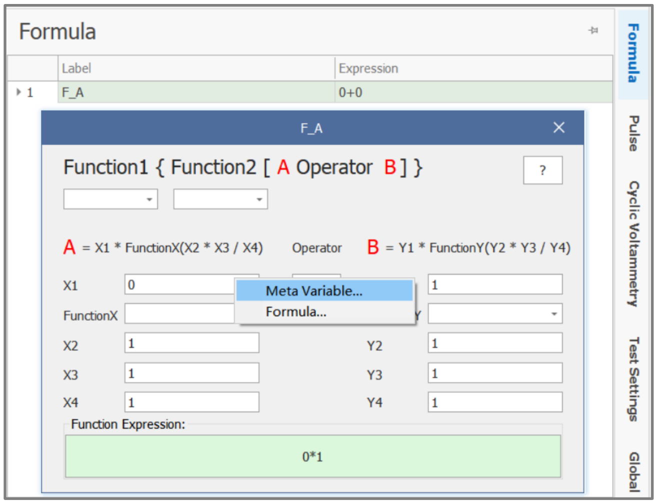


Figure 15-34 Apply Auxiliary Voltage in Formula

5) Select the auxiliary voltage AV_V in the Auxiliary Value of the “Meta Variable” Interface.
6) Set the Index Value.
    a) The default Index is Any.
    b) You can customize the Index Value to a specific channel number (1, 2, 3, etc.).
7) Click the “OK” button at the bottom of the “Meta Variable” Interface to save the changes.

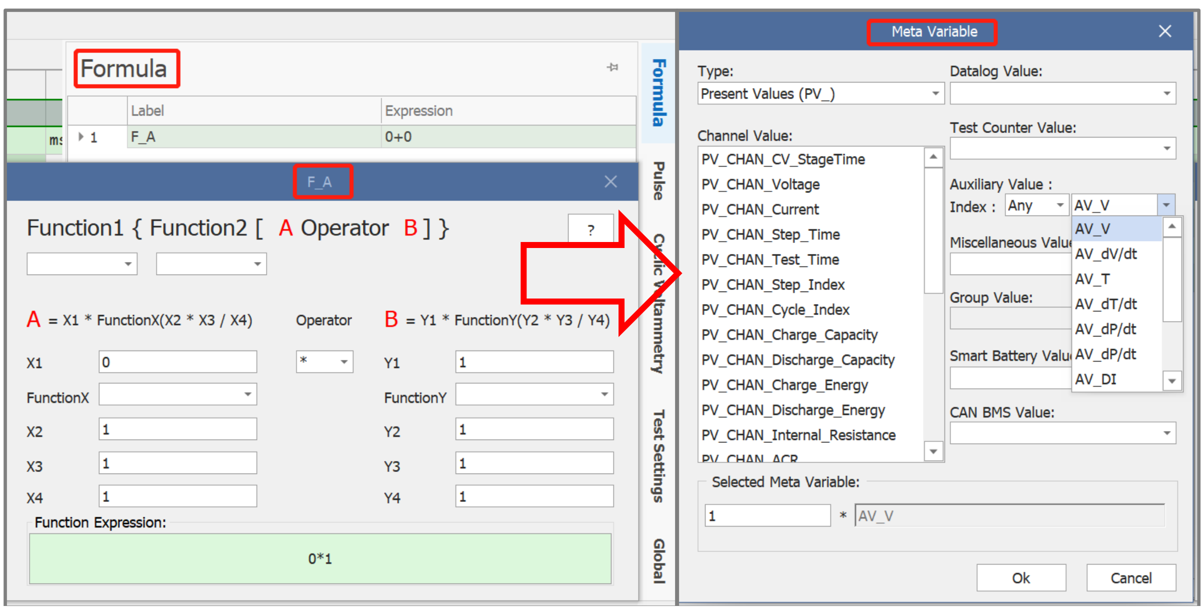


Figure 15-35 Configure Auxiliary Voltage in Meta Variable

Apply Auxiliary Voltage in a Step/Limit

The auxiliary voltage can be used as a variable and formula applied to the control value of Step and the variable value of Limit.

As a variable, the application steps are as follows:

1) Right-click the Control Value of the Step.
2) Click on the “Meta Variable” option in the menu that appears.
3) Click on the “More…” option in the drop-down menu to open the “Meta Variable” Interface.

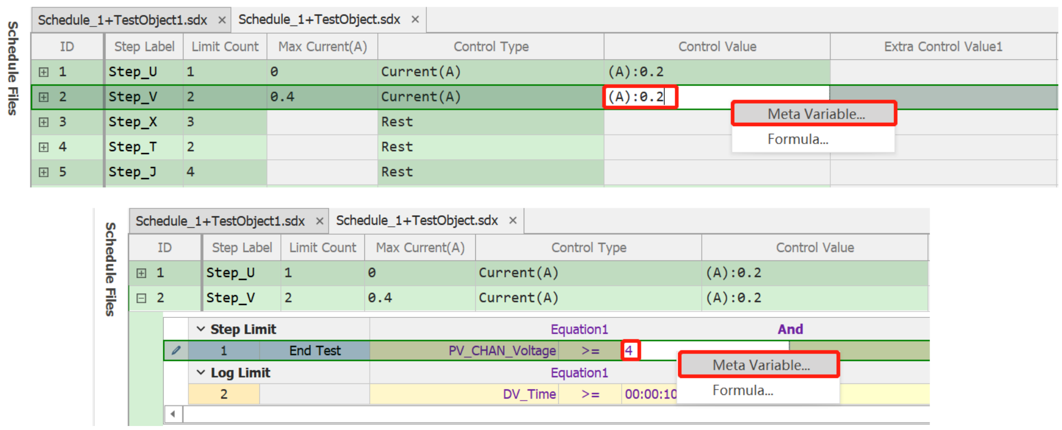


Figure 15-36 Configure Auxiliary Voltage in Step/Limit

4) Configure the auxiliary voltage in the Auxiliary Value on the Meta Variable page. (Note: When the auxiliary voltage is used as the Control Value, Index cannot be Any.)

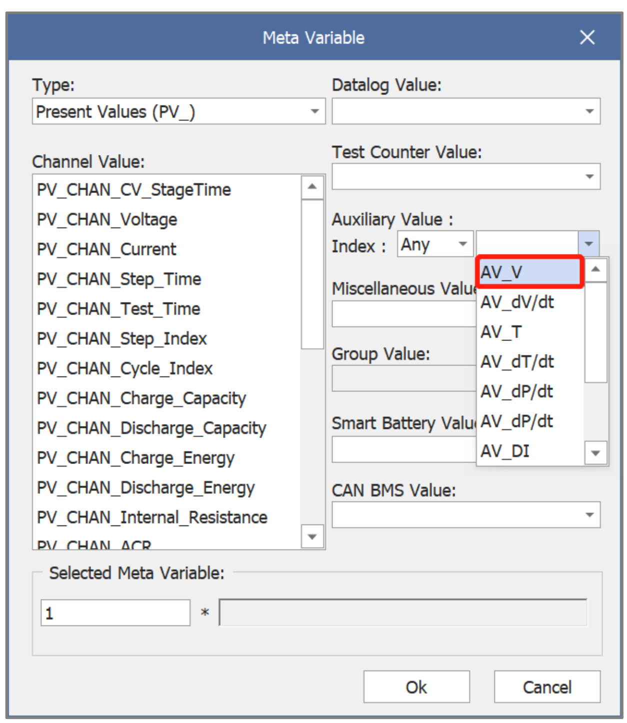


Figure 15-37 Configure the Auxiliary Voltage in the Meta Variable Pop-Up Interface

5) Click the “OK” on the Meta Variable Interface to successfully apply the variable.

Figure 15-38 shows a Schedule File with a successfully applied variable.

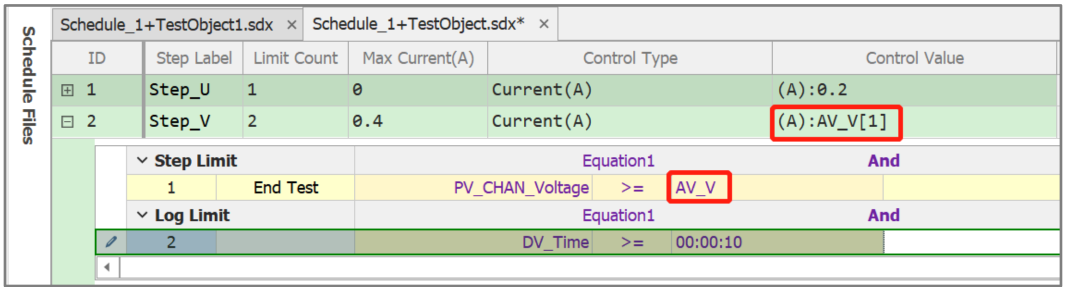


Figure 15-38 Select the Auxiliary Voltage as Meta Variable

As a Formula, the application steps are as follows:

1) Right-click the Control Value of the Step/variable value of Limit.
2) Click on the “Formula…” option in the menu that appears to open the “FormulaList” Interface.

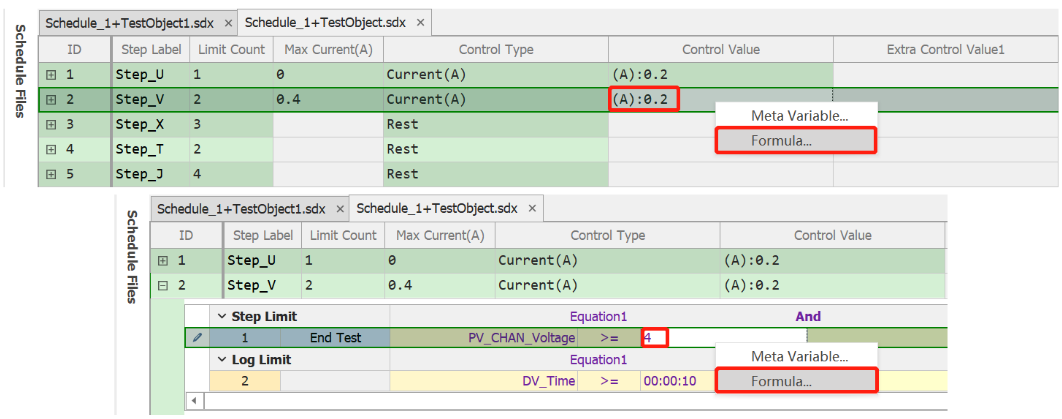


Figure 15-39 Apply Auxiliary Voltage in Formula

3) Select the corresponding Formula in the “FormulaList” Interface.

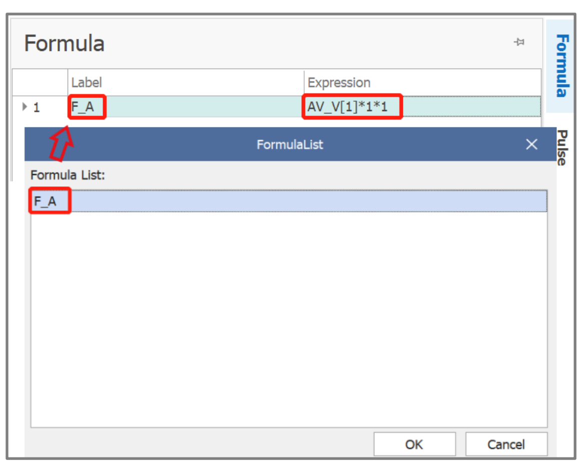


Figure 15-40 Formula Selection

4) Click the “OK” button at the bottom of the “FormulaList” Interface.

Figure 15-41 shows a Schedule File with a successfully applied formula.

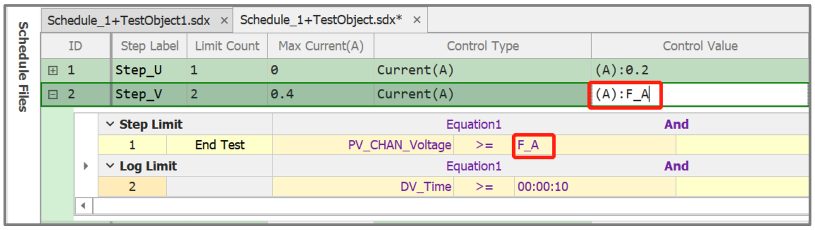


Figure 15-41 Effect of Applying Auxiliary Voltage Formula

15.2.6 View Auxiliary Voltage Data

You can view auxiliary voltage data through DataWatcher or Monitor.

View Auxiliary Voltage Data in DataWatcher

There are 3 ways to view data in DataWatcher: graphs, tables, and Excel files.

1) Display auxiliary data in the graph of DataWatcher.
   a) Open DataWatcher from the Monitor (select the channel and click the DataWatcher icon) or in the installation directory of DataWatcher.

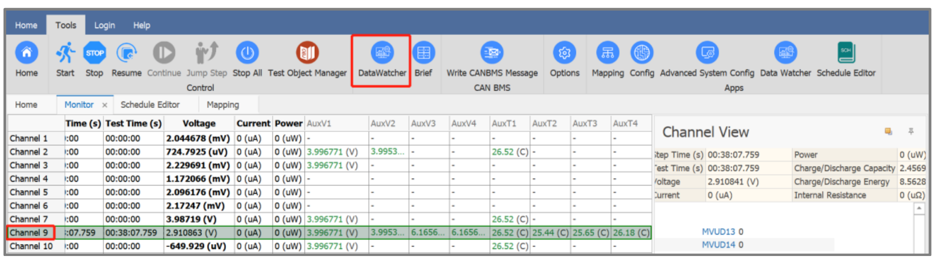


Figure 15-42 Open the DataWatcher from the Monitor

   b) Under the Data Source section in DataWatcher, select the test file.
   c) Click “Add to Selected” to add the test file to the data you want to display.
   d) Click “Plot Data” to go to the Selected Data page.

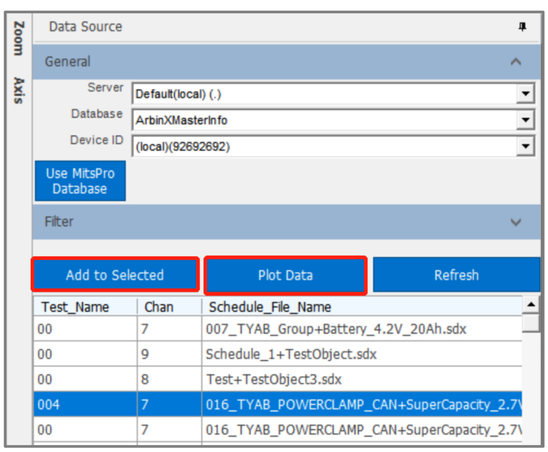


Figure 15-43 Select Data

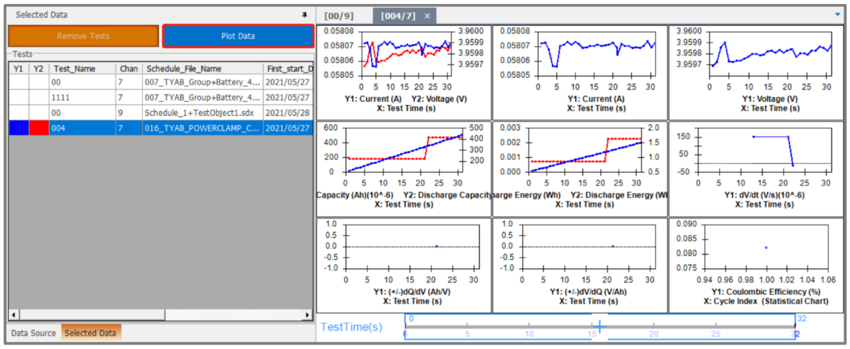


Figure 15-44 Display Data

e) Double-click on a chart to open a larger view of the selected chart.
f) Click on the “Y1” icon at the top of DataWatcher.
g) Select the auxiliary channel number.
h) Click to select the auxiliary data you want to display from the menu that appears.

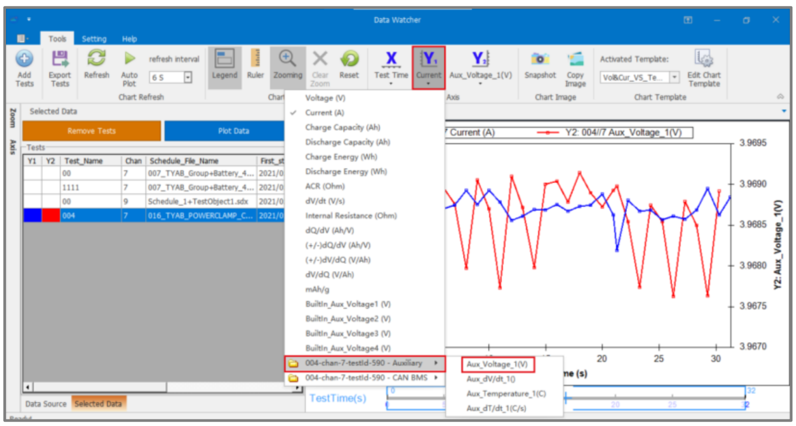
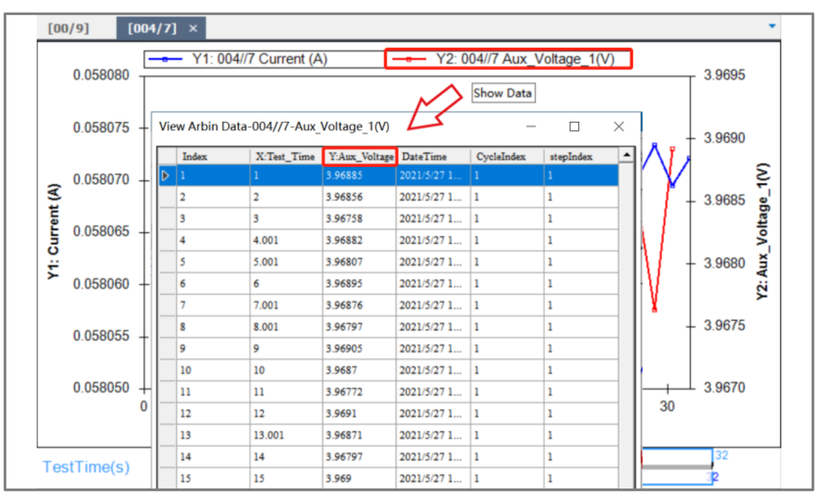


Figure 15-45 View the Data in the Graph

2) Display auxiliary data in the tables of DataWatcher.
   a) Click on the “Show Data” button in the figure to open the data table and view the data.



Index	X:Test_Time	Y:Aux_Voltage	DateTime	CycleIndex	stepIndex
1	1	3.96885	2021/5/27 1...	1	1
2	2	3.96856	2021/5/27 1...	1	1
3	3	3.96758	2021/5/27 1...	1	1
4	4.001	3.96882	2021/5/27 1...	1	1
5	5.001	3.96807	2021/5/27 1...	1	1
6	6	3.96895	2021/5/27 1...	1	1
7	7.001	3.96876	2021/5/27 1...	1	1
8	8.001	3.96797	2021/5/27 1...	1	1
9	9	3.96905	2021/5/27 1...	1	1
10	10	3.9687	2021/5/27 1...	1	1
11	11	3.96772	2021/5/27 1...	1	1
12	12	3.9691	2021/5/27 1...	1	1
13	13.001	3.96871	2021/5/27 1...	1	1
14	14	3.96797	2021/5/27 1...	1	1
15	15	3.969	2021/5/27 1...	1	1

Figure 15-46 View Data in the Table

3) View auxiliary data in an Excel or CSV file.
   a) Click on the “Export Test” icon in the toolbar to open the “Export” Interface.
   b) Under “File Type,” select either “To Excel” or “To CSV” based on the file type you want to export.
   c) Under the “Data Filter” section of the “Export” Interface, click the checkmark box to select “Auxiliary Data.”
   d) Click on the “Export to Files” button at the bottom of the “Export” Interface to export the data.

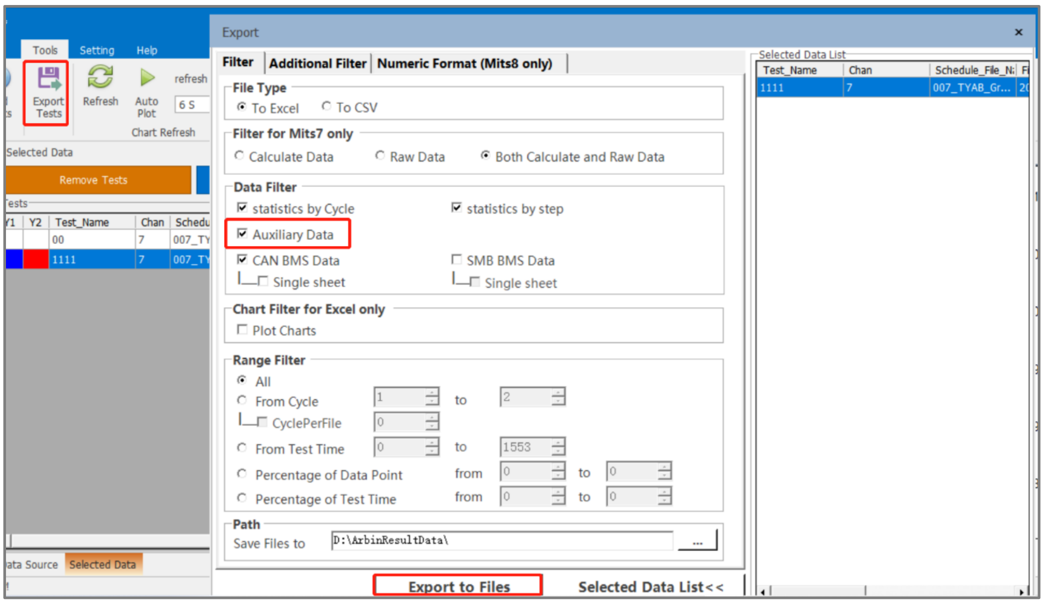


Figure 15-47 Export Excel Data

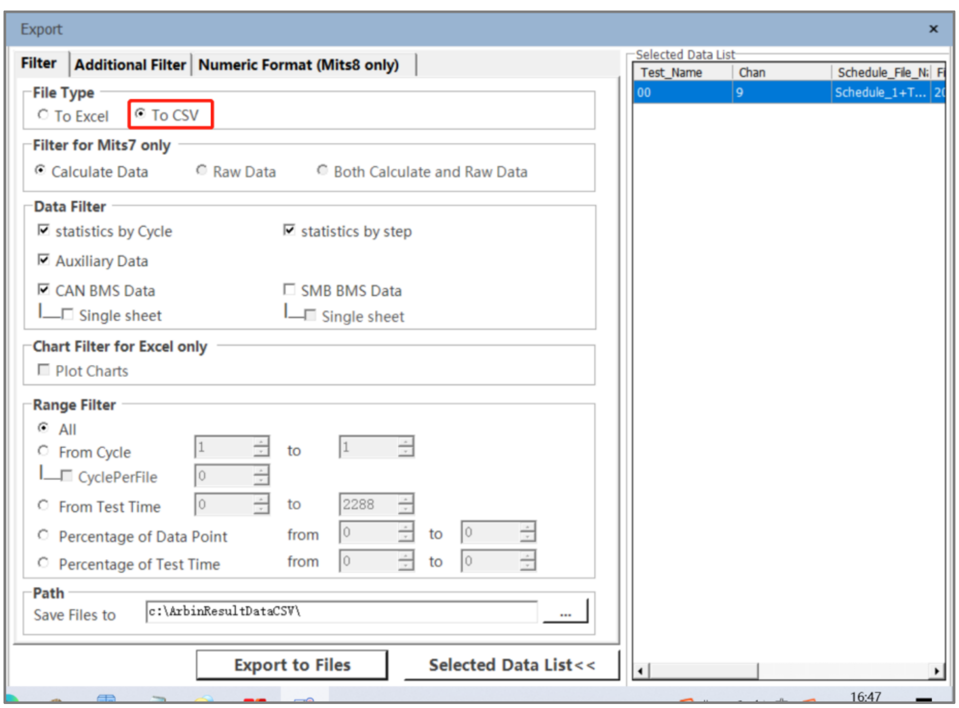


Figure 15-48 Export CSV Data

e) Select the file and click Open.

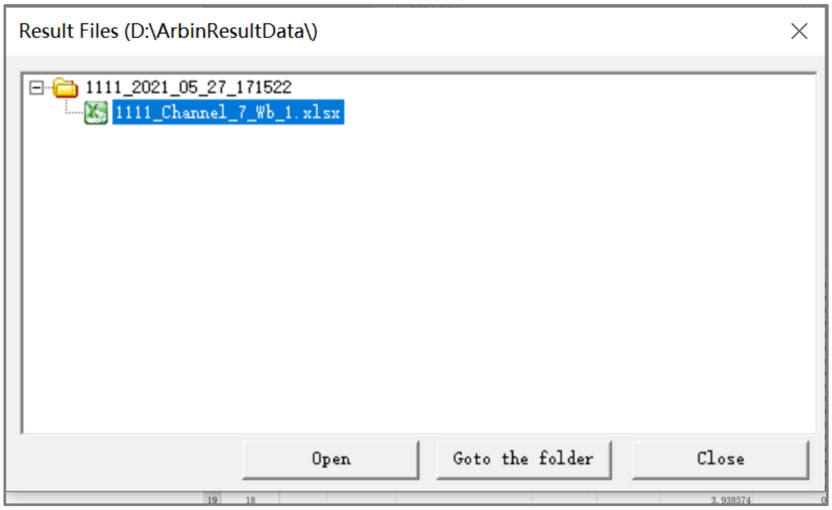


Figure 15-49 Open Excel data

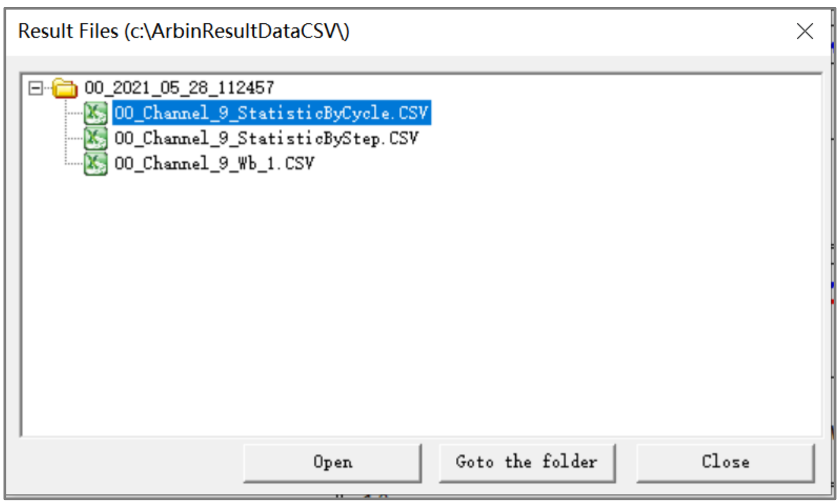
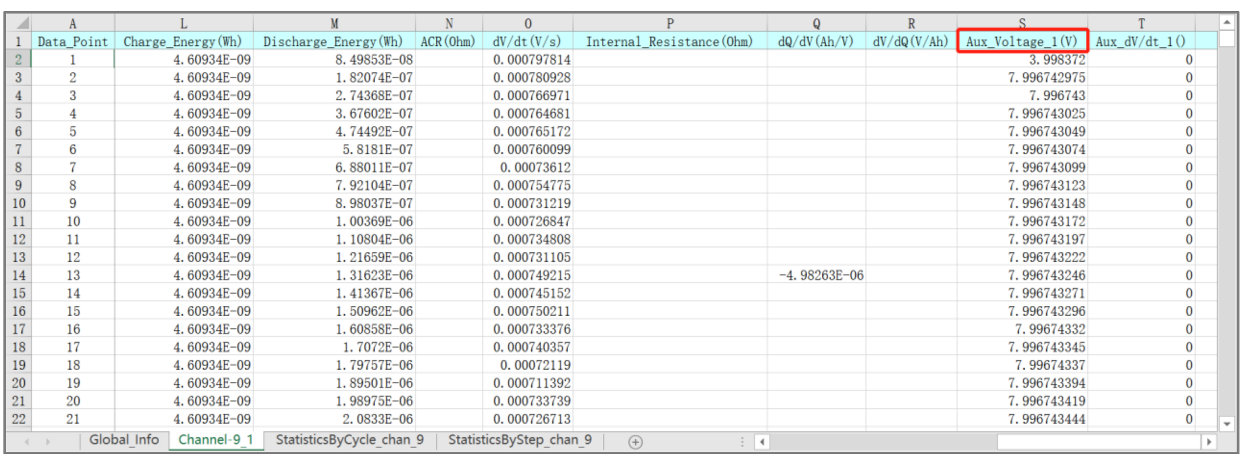


Figure 15-50 Open CSV Data

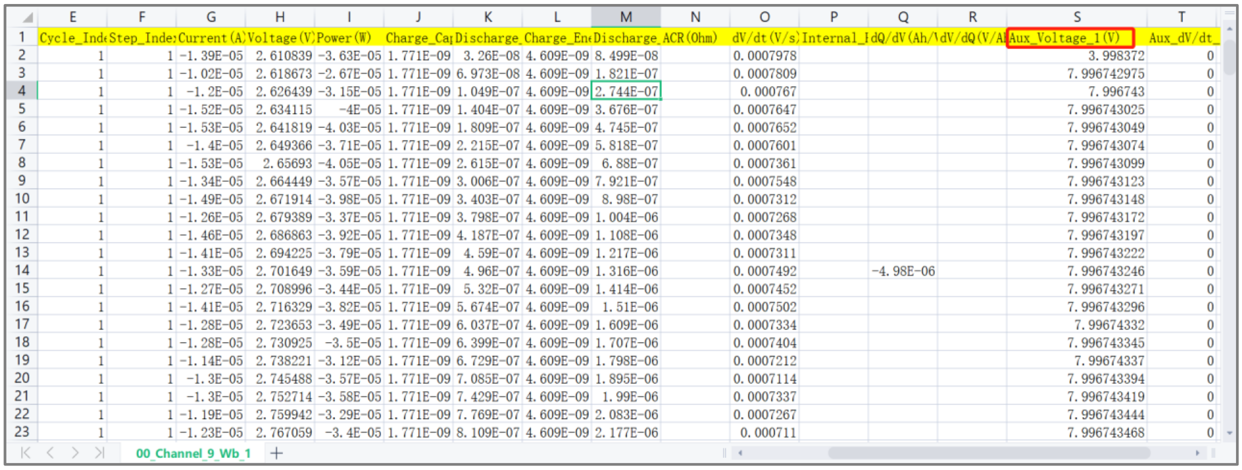
f) View the data in Excel.



	A	L	M	N	O	P	Q	R	S	T
1	Data_Point	Charge_Energy(Wh)	Discharge_Energy(Wh)	ACR(Ohm)	dV/dt(V/s)	Internal_Resistance(Ohm)	dQ/dV(Ah/V)	dV/dQ(V/Ah)	Aux_Voltage_1(V)	Aux_dV/dt_1()
2	1	4.60934E-09	8.49853E-08		0.000797814				3.998372	0
3	2	4.60934E-09	1.82074E-07		0.000780928				7.996742975	0
4	3	4.60934E-09	2.74368E-07		0.000766971				7.996743	0
5	4	4.60934E-09	3.67602E-07		0.000764681				7.996743025	0
6	5	4.60934E-09	4.74492E-07		0.000765172				7.996743049	0
7	6	4.60934E-09	5.8181E-07		0.000760099				7.996743074	0
8	7	4.60934E-09	6.88011E-07		0.00073612				7.996743099	0
9	8	4.60934E-09	7.92104E-07		0.000754775				7.996743123	0
10	9	4.60934E-09	8.98037E-07		0.000731219				7.996743148	0
11	10	4.60934E-09	1.00369E-06		0.000726847				7.996743172	0
12	11	4.60934E-09	1.10804E-06		0.000734808				7.996743197	0
13	12	4.60934E-09	1.21659E-06		0.000731105				7.996743222	0
14	13	4.60934E-09	1.31623E-06		0.000749215		-4.98263E-06		7.996743246	0
15	14	4.60934E-09	1.41367E-06		0.000745152				7.996743271	0
16	15	4.60934E-09	1.50962E-06		0.000750211				7.996743296	0
17	16	4.60934E-09	1.60858E-06		0.000733376				7.99674332	0
18	17	4.60934E-09	1.7072E-06		0.000740357				7.996743345	0
19	18	4.60934E-09	1.79757E-06		0.00072119				7.99674337	0
20	19	4.60934E-09	1.89501E-06		0.000711392				7.996743394	0
21	20	4.60934E-09	1.98975E-06		0.000733739				7.996743419	0
22	21	4.60934E-09	2.0833E-06		0.000726713				7.996743444	0

Global_Info | Channel-9_1 | StatisticsByCycle_chan_9 | StatisticsByStep_chan_9

Figure 15-51 View Excel Data

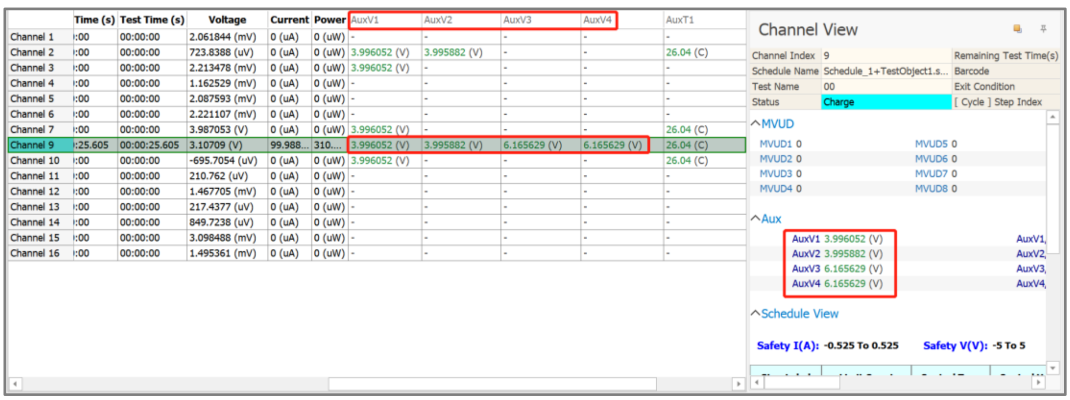


	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	Cycle_Inde	Step_Inde	Current (A	Voltage (V	Power (W)	Charge_Ca	Discharge_	Charge_En	Discharge_ACR (Ohm)		dV/dt (V/s	Internal_I	dQ/dV (Ah/	dV/dQ (V/A	Aux_Voltage_1 (V)	Aux_dV/dt_
2	1	1	-1.39E-05	2.610839	-3.63E-05	1.771E-09	3.26E-08	4.609E-09	8.499E-08		0.0007978				3.998372	0
3	1	1	-1.02E-05	2.618673	-2.67E-05	1.771E-09	6.973E-08	4.609E-09	1.821E-07		0.0007809				7.996742975	0
4	1	1	-1.2E-05	2.626439	-3.15E-05	1.771E-09	1.049E-07	4.609E-09	2.744E-07		0.000767				7.996743	0
5	1	1	-1.52E-05	2.634115	-4E-05	1.771E-09	1.404E-07	4.609E-09	3.676E-07		0.0007647				7.996743025	0
6	1	1	-1.53E-05	2.641819	-4.03E-05	1.771E-09	1.809E-07	4.609E-09	4.745E-07		0.0007652				7.996743049	0
7	1	1	-1.4E-05	2.649366	-3.71E-05	1.771E-09	2.215E-07	4.609E-09	5.818E-07		0.0007601				7.996743074	0
8	1	1	-1.53E-05	2.65693	-4.05E-05	1.771E-09	2.615E-07	4.609E-09	6.88E-07		0.0007361				7.996743099	0
9	1	1	-1.34E-05	2.664449	-3.57E-05	1.771E-09	3.006E-07	4.609E-09	7.921E-07		0.0007548				7.996743123	0
10	1	1	-1.49E-05	2.671914	-3.98E-05	1.771E-09	3.403E-07	4.609E-09	8.98E-07		0.0007312				7.996743148	0
11	1	1	-1.26E-05	2.679389	-3.37E-05	1.771E-09	3.798E-07	4.609E-09	1.004E-06		0.0007268				7.996743172	0
12	1	1	-1.46E-05	2.686863	-3.92E-05	1.771E-09	4.187E-07	4.609E-09	1.108E-06		0.0007348				7.996743197	0
13	1	1	-1.41E-05	2.694225	-3.79E-05	1.771E-09	4.59E-07	4.609E-09	1.217E-06		0.0007311				7.996743222	0
14	1	1	-1.33E-05	2.701649	-3.59E-05	1.771E-09	4.96E-07	4.609E-09	1.316E-06		0.0007492		-4.98E-06		7.996743246	0
15	1	1	-1.27E-05	2.708996	-3.44E-05	1.771E-09	5.32E-07	4.609E-09	1.414E-06		0.0007452				7.996743271	0
16	1	1	-1.41E-05	2.716329	-3.82E-05	1.771E-09	5.674E-07	4.609E-09	1.51E-06		0.0007502				7.996743296	0
17	1	1	-1.28E-05	2.723653	-3.49E-05	1.771E-09	6.037E-07	4.609E-09	1.609E-06		0.0007334				7.99674332	0
18	1	1	-1.28E-05	2.730925	-3.5E-05	1.771E-09	6.399E-07	4.609E-09	1.707E-06		0.0007404				7.996743345	0
19	1	1	-1.14E-05	2.738221	-3.12E-05	1.771E-09	6.729E-07	4.609E-09	1.798E-06		0.0007212				7.99674337	0
20	1	1	-1.3E-05	2.745488	-3.57E-05	1.771E-09	7.085E-07	4.609E-09	1.895E-06		0.0007114				7.996743394	0
21	1	1	-1.3E-05	2.752714	-3.58E-05	1.771E-09	7.429E-07	4.609E-09	1.99E-06		0.0007337				7.996743419	0
22	1	1	-1.19E-05	2.759942	-3.29E-05	1.771E-09	7.769E-07	4.609E-09	2.083E-06		0.0007267				7.996743444	0
23	1	1	-1.23E-05	2.767059	-3.4E-05	1.771E-09	8.109E-07	4.609E-09	2.177E-06		0.000711				7.996743468	0

Figure 15-52 View CSV Data

View Auxiliary Voltage Data in Monitor

1) Open the Monitor and view it in the main page (Detail View/Brief View) or Channel View Interface.



	Time (s)	Test Time (s)	Voltage	Current	Power	AuxV1	AuxV2	AuxV3	AuxV4	AuxT1
Channel 1	:00	00:00:00	2.061844 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 2	:00	00:00:00	723.8388 (uV)	0 (uA)	0 (uW)	3.996052 (V)	3.995882 (V)	-	-	26.04 (C)
Channel 3	:00	00:00:00	2.213478 (mV)	0 (uA)	0 (uW)	3.996052 (V)	-	-	-	-
Channel 4	:00	00:00:00	1.162529 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 5	:00	00:00:00	2.087593 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 6	:00	00:00:00	2.221107 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 7	:00	00:00:00	3.987053 (V)	0 (uA)	0 (uW)	3.996052 (V)	-	-	-	26.04 (C)
Channel 9	:25.605	00:00:25.605	3.10709 (V)	99.988...	310....	3.996052 (V)	3.995882 (V)	6.165629 (V)	6.165629 (V)	26.04 (C)
Channel 10	:00	00:00:00	-695.7054 (uV)	0 (uA)	0 (uW)	3.996052 (V)	-	-	-	26.04 (C)
Channel 11	:00	00:00:00	210.762 (uV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 12	:00	00:00:00	1.467705 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 13	:00	00:00:00	217.4377 (uV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 14	:00	00:00:00	849.7238 (uV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 15	:00	00:00:00	3.098488 (mV)	0 (uA)	0 (uW)	-	-	-	-	-
Channel 16	:00	00:00:00	1.495361 (mV)	0 (uA)	0 (uW)	-	-	-	-	-

Figure 15-53 View Data in Monitor

15.3 Digital Input/Output (DI/DO)

15.3.1 What is Digital Input/Output?

This auxiliary digital I/O enables software-controlled input and output and can be used to interact with customer-defined interfaces. It can be used to start electric pumps, shut down electric pumps according to external signals, and many other customer needs.

The digital input has two states: on and off. If the potential is low, the circuit is on. If the potential is high, the circuit is off.

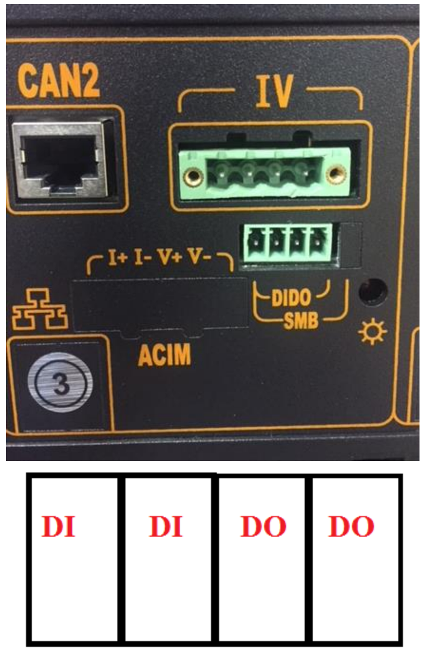


Figure 15-54 DIDO

Digital I/O stands for digital input and output. The digital input allows the MCU to detect the logic state, and the digital output allows the MCU to output the logic state.

There are two types of DIDO boards:

1) Relay type – The maximum current that can be driven by the relay is 12A.
2) TTL style – If the voltage is less than 0.5 V, the circuit board will see DIDO on (or false). If the voltage exceeds 4 V, the circuit board will see DIDO off (or true).

The digital output is used to output the on/off signal.

When DO=0 or true, then DI=closed circuit.

The digital input is used to discriminate the opening and closing of the circuit.

When DO=1 or false, DI=open circuit.

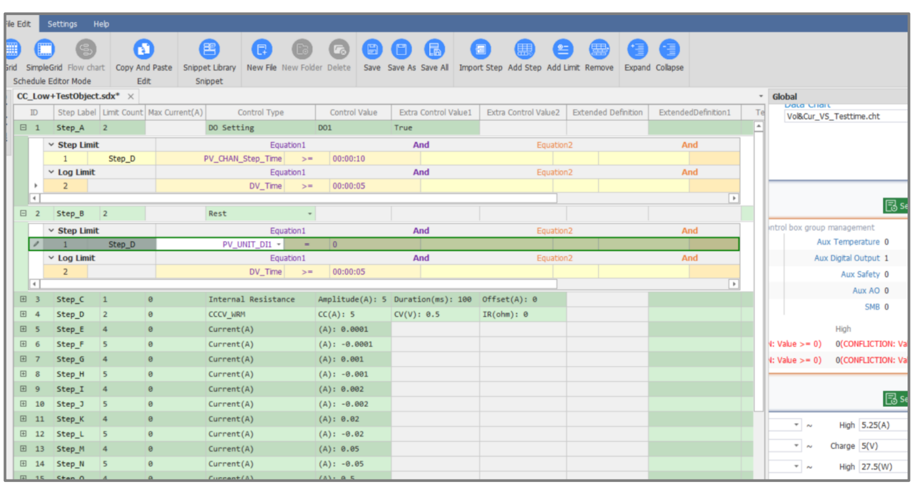


Figure 15-55 Edit DIDO Schedule

15.3.2 Edit the DI/DO Schedule

1) In the DIDO step, select “DO setting” as the Control Type.
2) Select DO1 as the Control Value.
3) Select either true or false for Extra Control Value 1 based on what you want DO1 to do.
4) Variable1 should be pv_chan_step_time>= the amount of time required for the DO1 step to run. For example, the Step Time in the Schedule above is set to 10 seconds.
5) The next step should be the Rest step, which Arbin uses to check the true/false status of DI1 (digital input 1) port through the PV_UNIT_DI1 variable and then jump to different steps according to the results of DI1.
6) If you want to insert the PV_UNIT_DI1 variable, do the following:
   a) Click on the Variable box and select “More…” from the drop-down menu.
   b) Select “PV_UNIT_DI1” in the “Meta Variable” Interface that appears.
   c) Click the “OK” button at the bottom of the “Meta Variable” Interface.

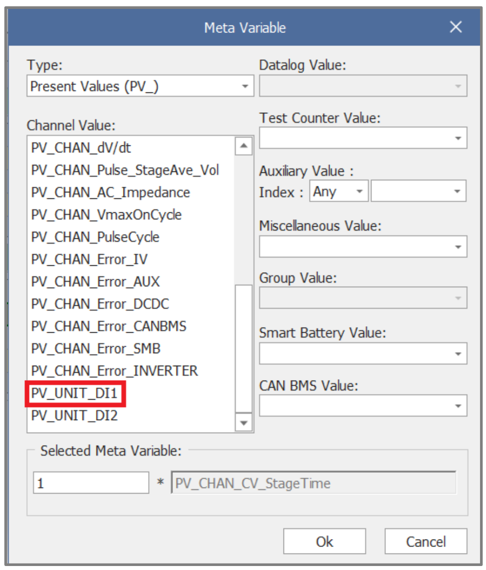


Figure 15-56 Select PV_Unit_DI1

7) In this Schedule, if DI1 is 0 (or true), the Step D will be executed. If DI1 is 1 (or false), it will stay in Step B.

16: Database Configuration

16.1 Introduction to Database Configuration

16.1.1 What is Database Configuration?

Database Config is used to configure connection properties such as database services, instances, accounts, and ports.

Open Database Config

1) Double-click the “Database Config” icon on the Console home page (Figure 16-1).

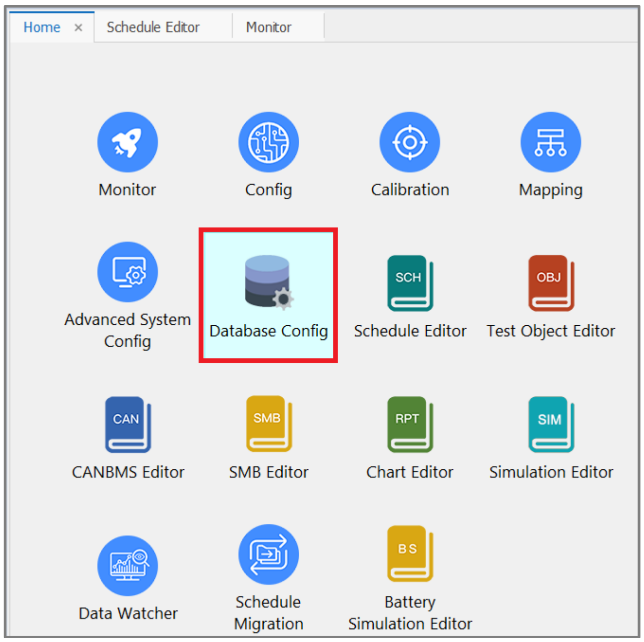


Figure 16-1 Open Database Config

16.2 Manage General Database Configuration Settings

16.2.1 Manage the CSV File Settings

With the General Database Configuration Settings, you can configure settings for the CSV file, buffer file, and the database.

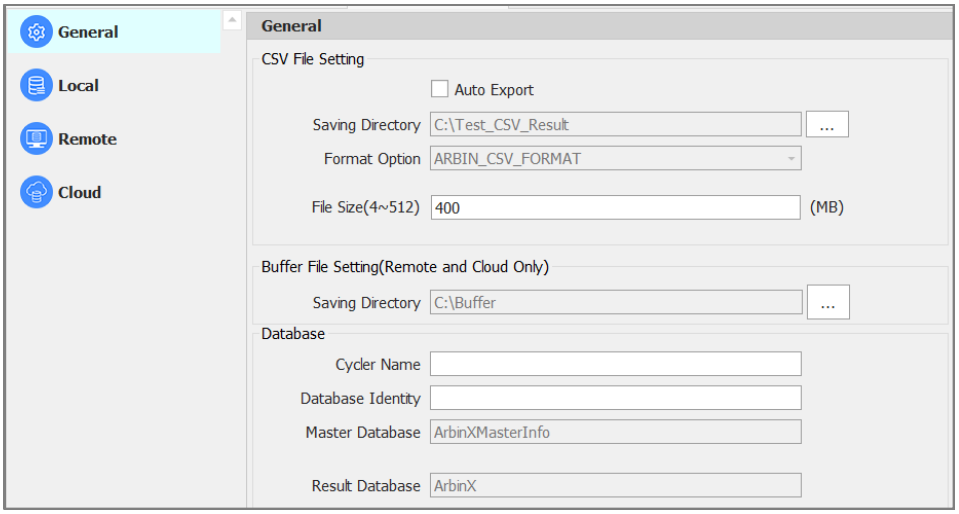


Figure 16-2 General Setting Page

1) **Auto Export** – When this option is selected, the system will export the data automatically.
2) **Saving Directory** – Set the storage path of the CSV file.
   a) Ensure that the “Auto Export” option is enabled.
   b) Click the three-dot icon to the right of the “Saving Directory” input field.
   c) In the “Browse For Folder” Interface that appears, navigate to and select the location to store the CSV file.
   d) Click the “OK” button at the bottom of the “Browse For Folder” Interface.

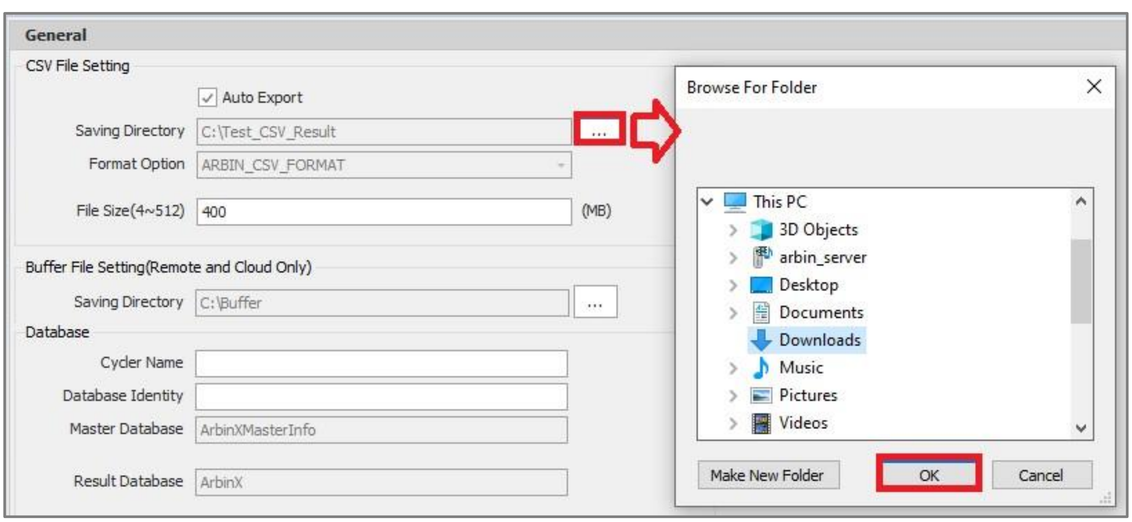


Figure 16-3 Set the CSV File Storage Path

3) **Format Option** – The CSV file storage currently only supports the ARBIN_CSV_Result format.
4) **File Size** – Set the size of the CSV file.

16.2.2 Manage the Buffer File Settings

1) **Saving Directory** – Set the save path of the buffer file.
   a) Click on the three dot icon to the right of the “Saving Directory” input field.
   b) In the “Browse For Folder” Interface that appears, navigate to and select the location to store the buffer file.
   c) Click the “OK” button at the bottom of the “Browse For Folder” Interface.

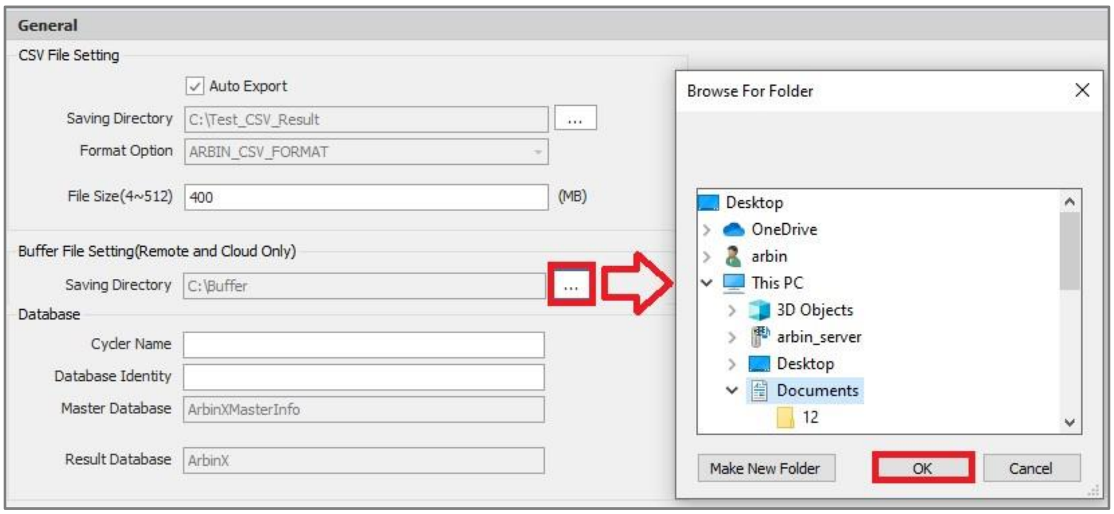


Figure 16-4 Set the Buffer File Storage Path

16.2.3 Manage the Database File Settings

1) **Cycler Name** – Fill in the device name.
2) **Database Identity** – Set the database ID.
3) **Master Database, Result Database** – The default is ArbinXMasterInfo and ArbinX.

16.3 Manage Local Database Configuration Settings

The local database will be opened by default and cannot be closed. The user needs to select the database type, either SQLServer or MySQL. The default is SQLServer.

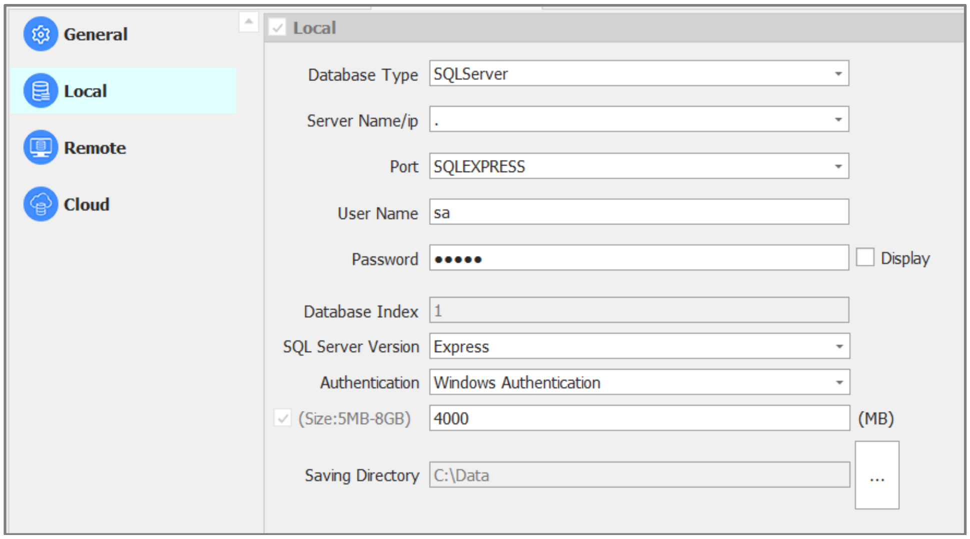


Figure 16-5 SQLServer Setting Page

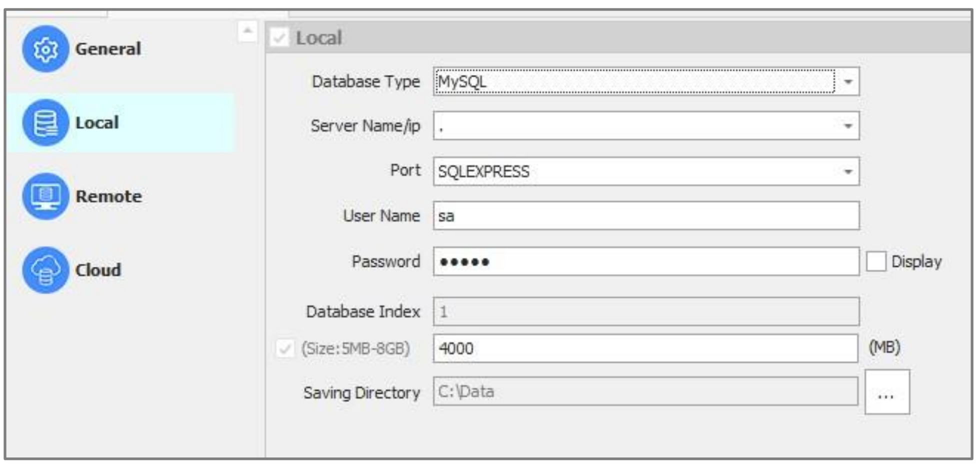


Figure 16-6 MySQL Setting Page

1) **Database Type** – Choose the database type, either SQLServer or MySQL.
2) **Server Name/IP** – Set the database server name or IP address.
3) **Port** – Set the database server port.
4) **User Name** – Enter your user name. The default is sa.
5) **Password** – Enter your password.
6) **Database Index** – The Database serial number.
7) **SQL Server Version** – Choose the SQL Server versions, Express and Non-Express.
8) **Authentication** – Choose the authentication method, pass Interfaces or SQL Server authentication.
9) **Size** – Set the size of the database file and add a limit to the size of the database file.

10) **Saving Directory** – Set the storage path.

a) Click on the three dot icon to the right of the "Saving Directory" input field.

b) In the "Browse For Folder" Interface that appears, navigate to and select the location to store the buffer file.

c) Click the "OK" button at the bottom of the "Browse For Folder" Interface.

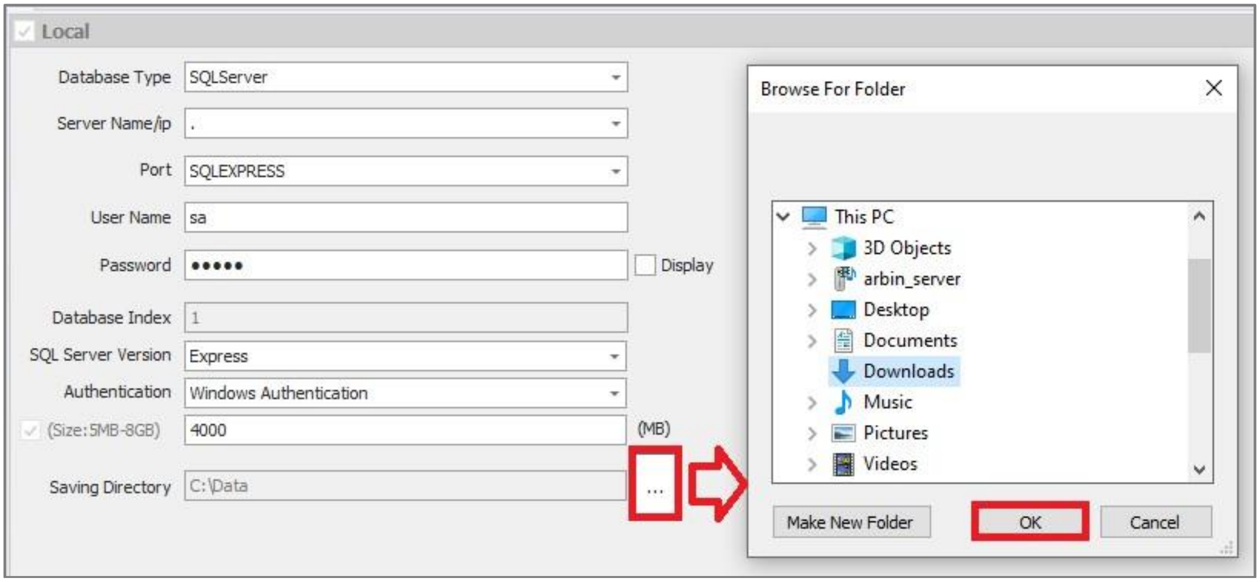


Figure 16-7 Set the Data Storage Path of the Local Database

d) After editing the settings, click the "Save" icon in the toolbar to save.

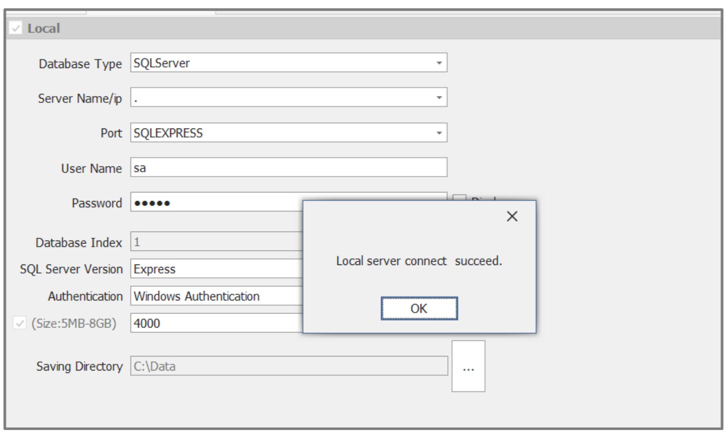


Figure 16-8 Local Database Connection is Successful

16.4 Manage Remote Database Configuration Settings

Remote Database – The Arbin battery test system can save test data locally and support saving data from multiple test platforms to the same remote database or cloud database. Customers can manage the test data of multiple test platforms on one SQL server, saving a lot of time. When using the remote database function, you need to ensure that the local computer's network connection is stable.

16.4.1 Enable Remote Connection to an SQL Server

1) Open the SQL Server Management Studio, referred to as SSMS here(Figure 16-9).

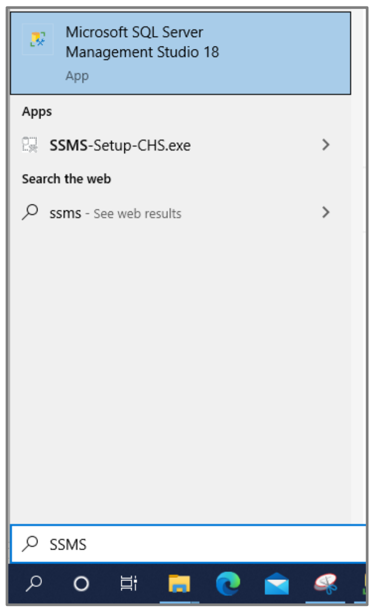


Figure 16-9 Open SQL Server Management Studio

2) In the SSMS, click Object Explorer → Connect → Database Engine.
3) In the Server name filed, enter the server name.
4) In the Authentication field, select "Interfaces Authentication."
5) Click the "Connect" button at the bottom of the Interface to connect to the SQL Server.

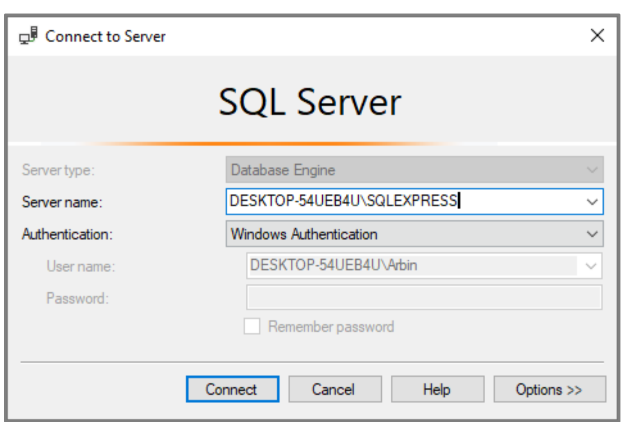


Figure 16-10 Connect to SQL Server

6) Right-click the server name in Object Explorer.
7) Select the “Properties” option in the menu that appears.

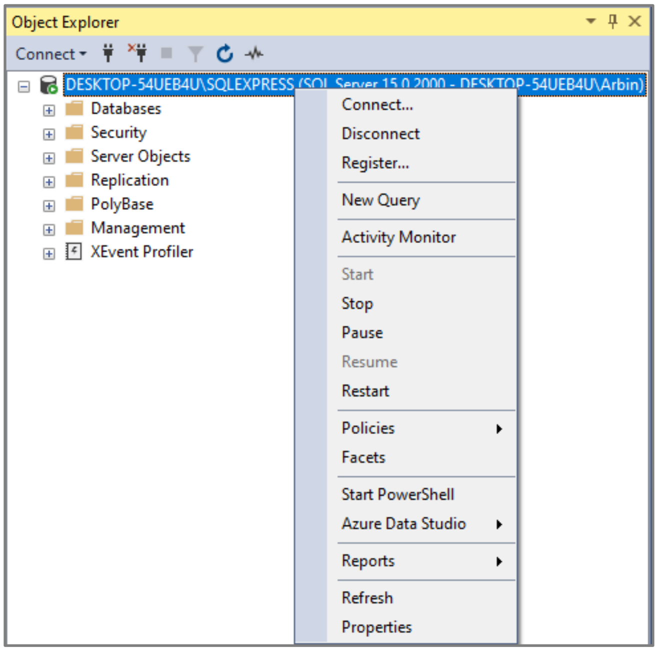


Figure 16-11 Right Click and Select Properties

8) On the Security page, click the circle for “Server and Interfaces Authentication mode” to allow users to log in with SQL permissions.

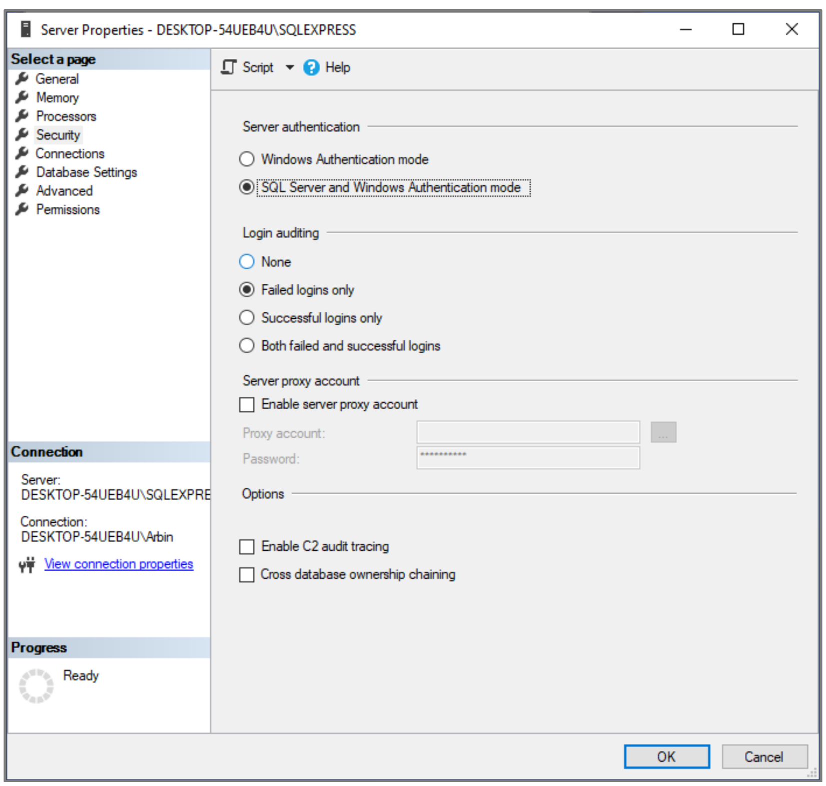


Figure 16-12 Allow Users to Log In with SQL Permissions

9) On the Connections interface under “Remote server connections,” click the circle for “Allow remote connection to this server” to enable this SQL Server to be accessed remotely.
10) Click the “OK” button at the bottom of the Interface.

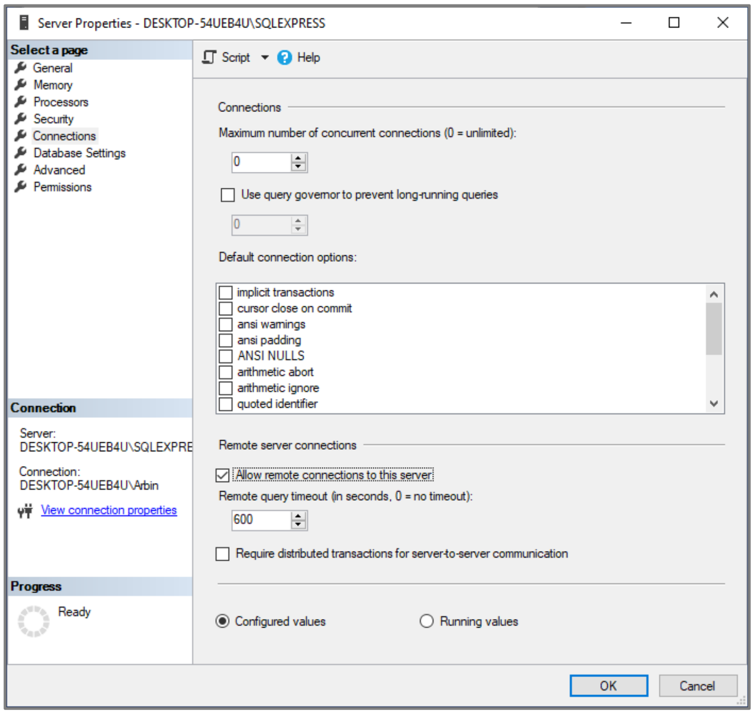


Figure 16-13 Allow Remote Connection to This Server

11) Under the server name, find Security → Logins → sa.
12) Right-click on the “sa” item.
13) Click on the “Properties” option in the menu that appears.

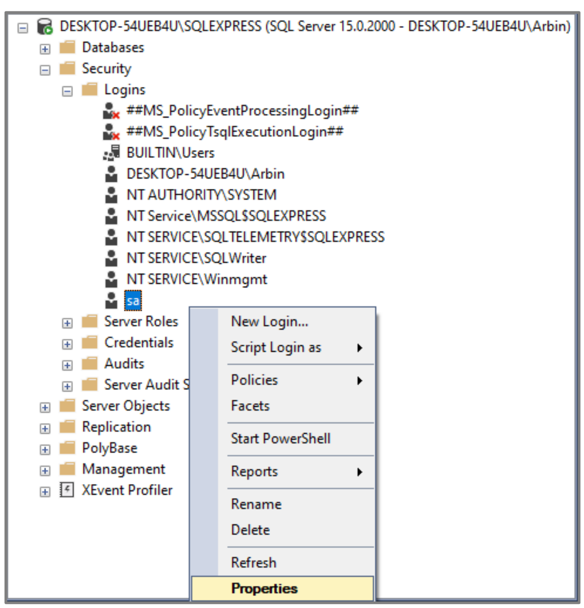


Figure 16-14 Right-Click and Select SA Properties

14) Configure the General page settings.
   a) Change the password to “arbin.”
   b) Click the checkmark box to remove the check and turn off the “Enforce password policy” option.

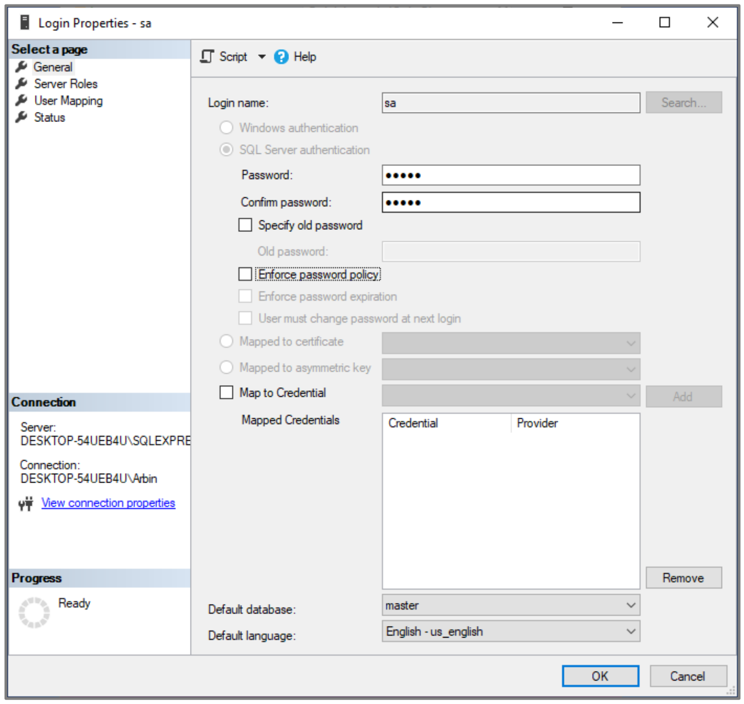


Figure 16-15 Change Password

15) On the Status page, under “Login,” select the “Enabled” option.
16) Click the “OK” button at the bottom of the Interface to save the settings.

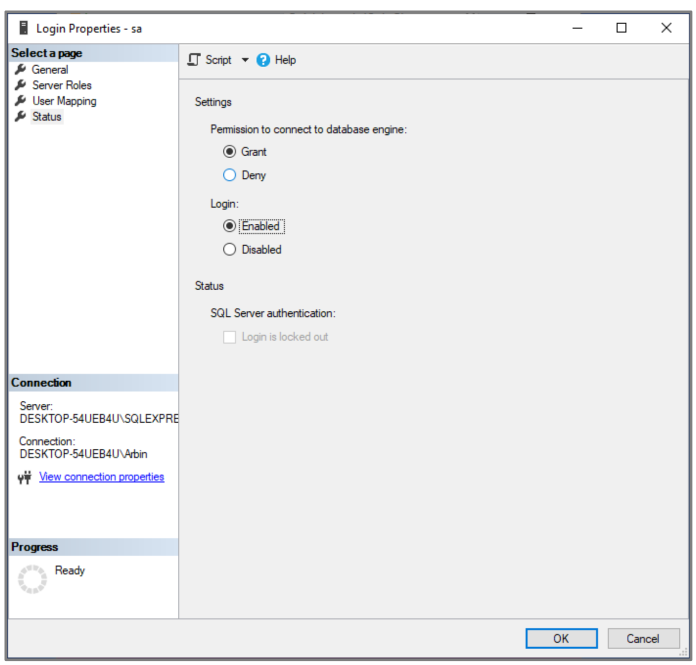


Figure 16-16 Login Enabled

17) Open SQL Server Configuration Manager.

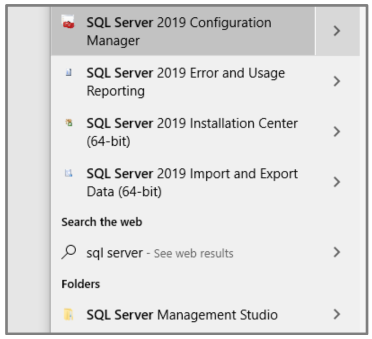


Figure 16-17 Open SQL Server Configuration Manager

18) Navigate to SQL Server Configuration Manager (Local) → SQL Server Network Configuration → Protocols for SQLEXPRESS → TCP/IP.
19) Right-click on TCP/IP item.
20) Click on the "Properties" option in the menu that appears.

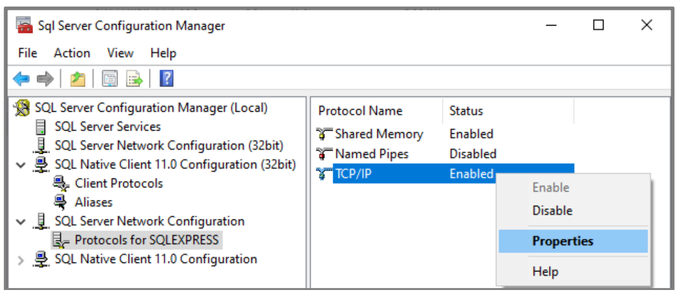


Figure 16-18 TCP/IP Properties

21) Configure the Protocol page settings under General.
   a) For Enabled, select "Yes."
   b) For Listen All, select "Yes."

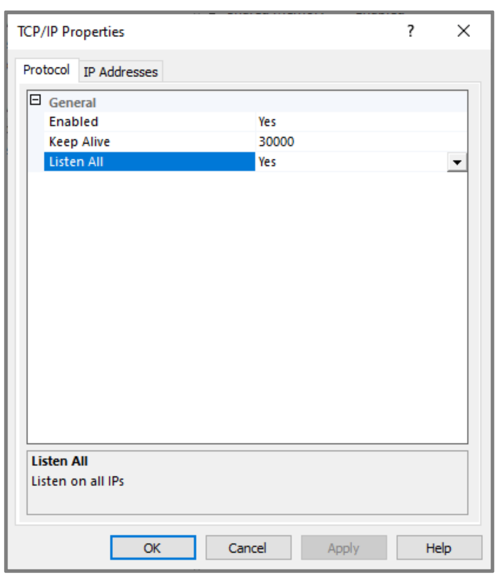


Figure 16-19 Configure Listen All

22) Configure the IP Address settings.
    a) Look for the same IP address as the local IPv4 and configure the following under that section of the IP Address tab.
    b) Under Active, select “Yes.”
    c) Change TCP Dynamic Ports to “1433.”
23) Click the “OK” button at the bottom of the TCP/IP Properties Interface to save the settings.

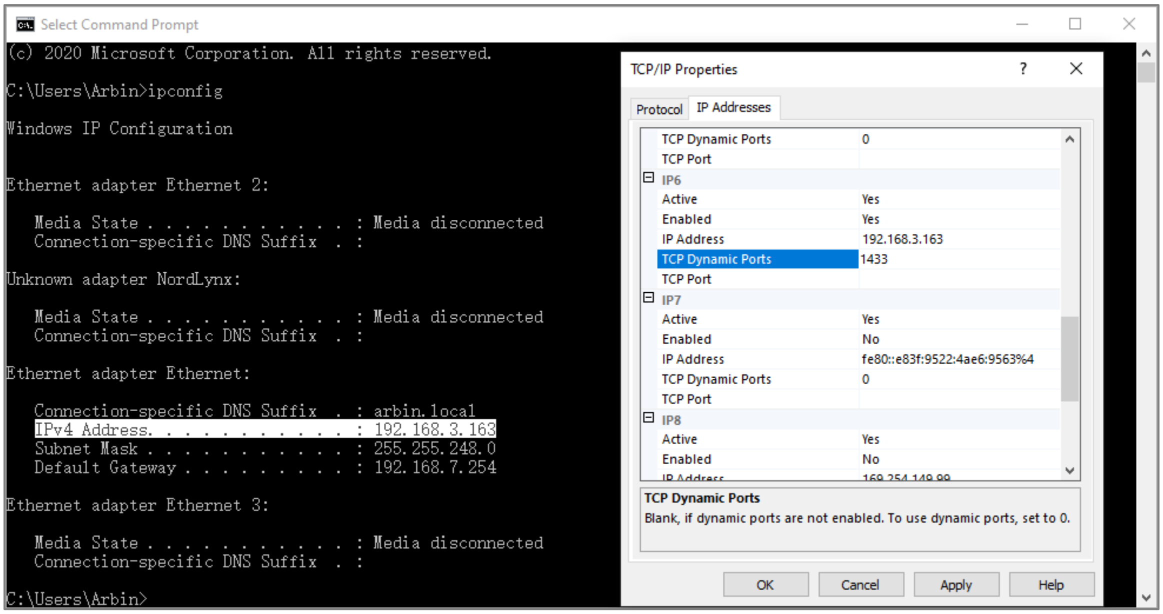


Figure 16-20 Modify TCP Dynamic Ports

24) Finally, locate SQL Server Configuration Manager (Local) → SQL Server Services → SQL Server (SQLEXPRESS).
25) Right-click on SQL Server (SQLEXPRESS).
26) Click on the “Restart” option in the menu that appears to restart SQL Server service.

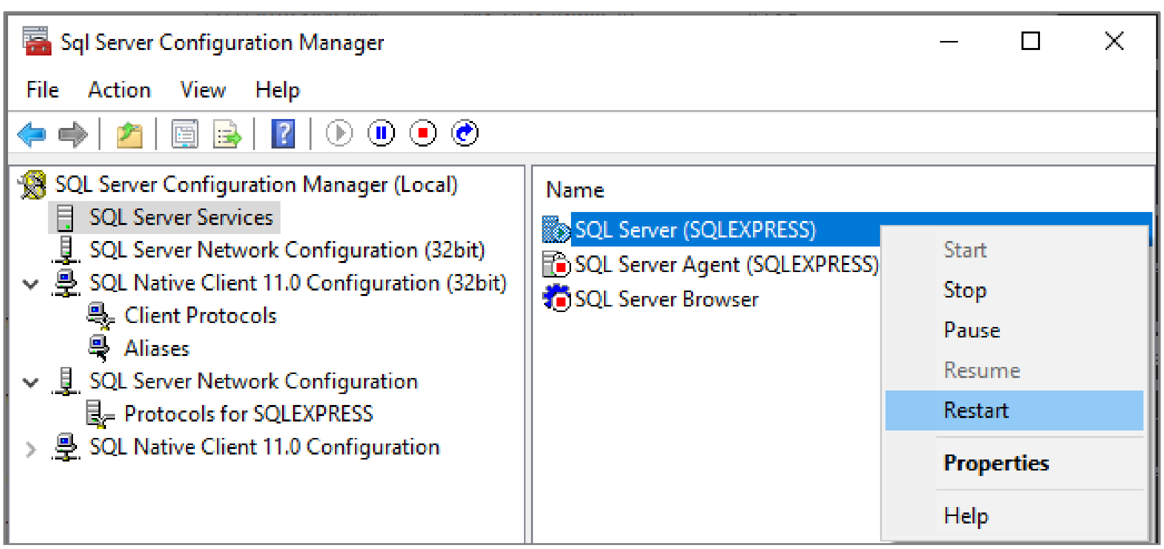


Figure 16-21 Restart SQL Server

16.4.2 Set the Remote Database Configuration in Mits X

1) Open Mits X and click on the “Database Config” icon on the home page.

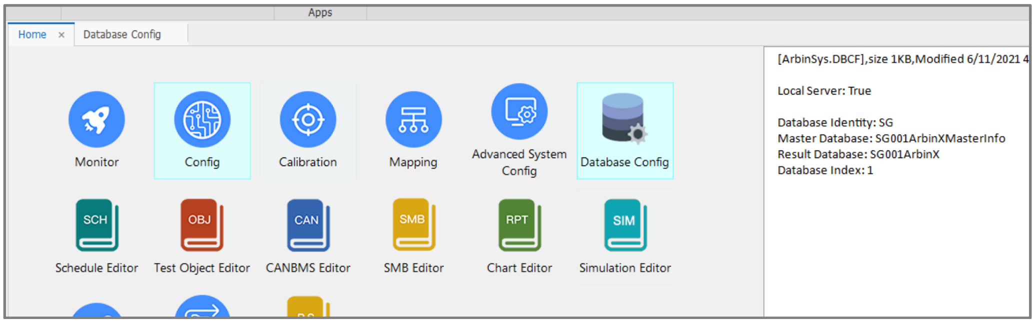


Figure 16-22 Open Database Config

2) Configure the Remote page settings
   a) Click the checkmark box to select the “Remote” option.
   b) In the Server Name/Ip input field, fill in the IP address of the remote server.
   c) In the User Name input field, enter “sa.”
   d) In the Password input field, enter “arbin.”
   e) Click the “Save” icon at the top of the Console to save the settings.

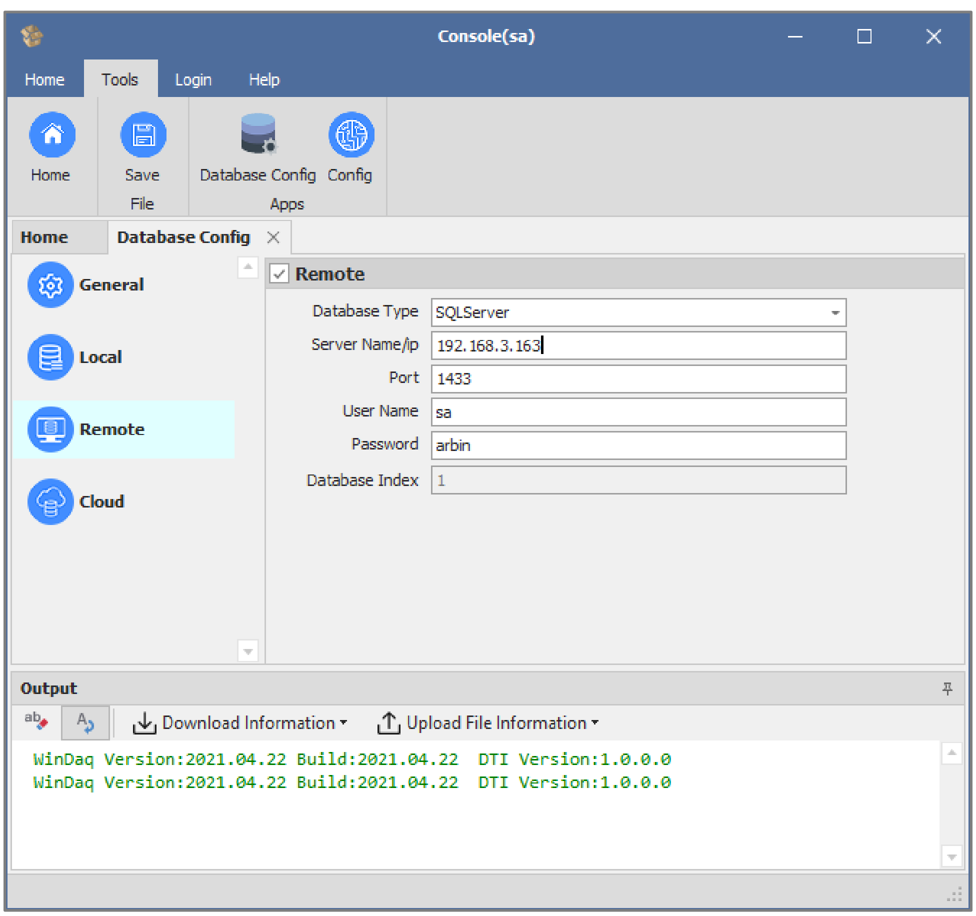


Figure 16-23 Configure Remote Page Settings

16.4.3 View the Remote SQL Database in DataWatcher

1) Open DataWatcher and click on the “Setting” tab at the top of DataWatcher.
2) Click on the “Database Config” icon in the toolbar.

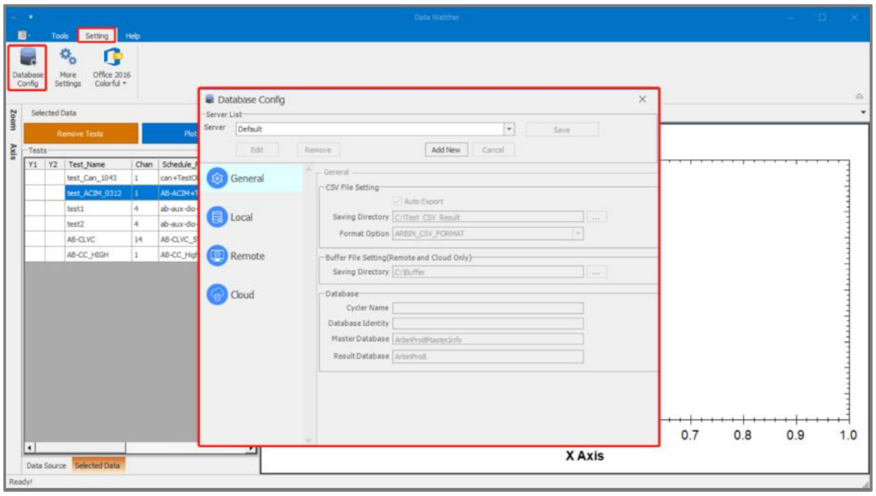


Figure 16-24 Open DataWatcher Database Config

3) Click on the “Add New” button under the “Server” field.
4) Click on the “Remote” icon on the left of the “Database Config” Interface to view the Remote page.
   a) Click the checkmark box to select the “Remote” option.
   b) In the Server Name/Ip input field, fill in the IP address of the remote server.
   c) In the User Name input field, enter “sa.”
   d) In the Password input field, enter “arbin.”
   e) Click the “Save” icon at the top of the “Database Config” Interface to save the settings.

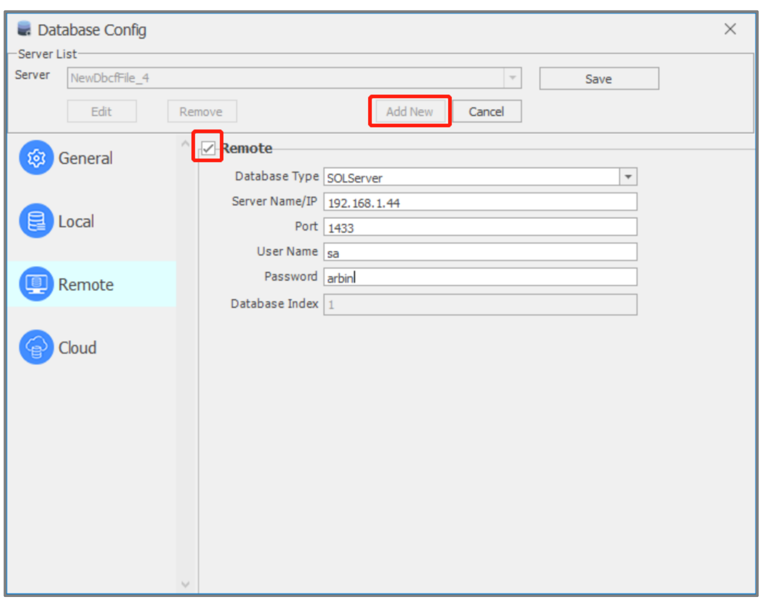


Figure 16-25 Configure Database Config 1 of DataWatcher

5) On the main DataWatcher interface, under the "General" section in the Data Source column, select the added remote database.
   a) You can switch between multiple servers using the Server drop-down menu.

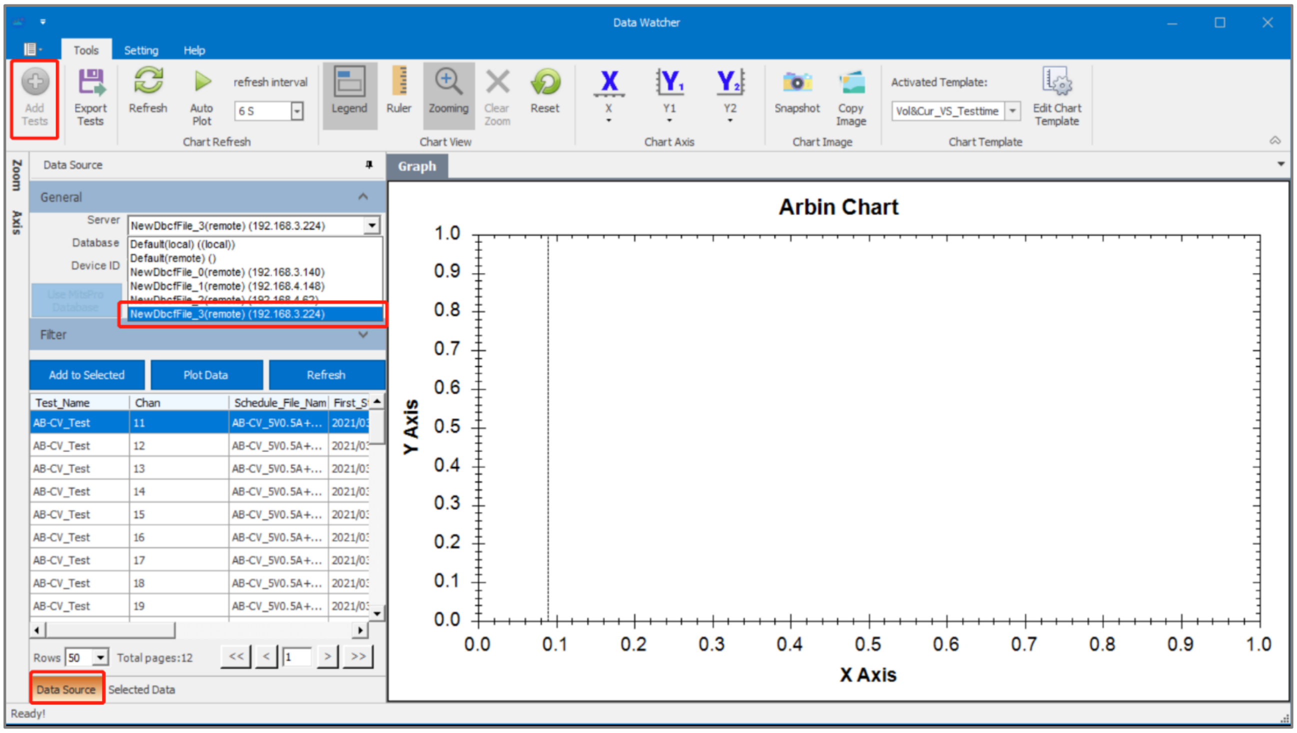


Figure 16-26 Select SQL Server

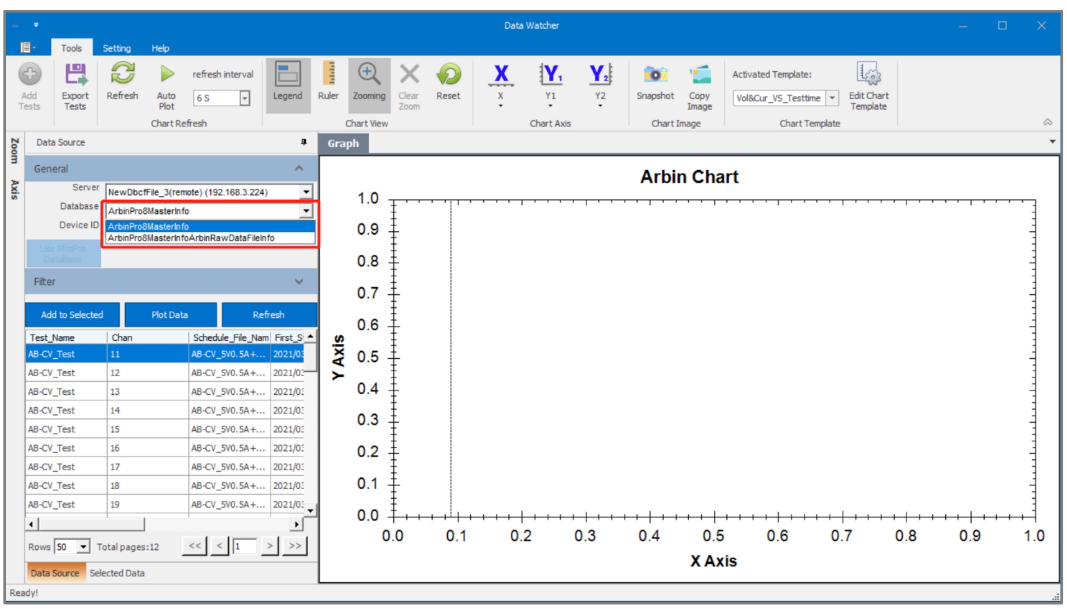


Figure 16-27 Switch Between Servers

b) You can switch between multiple Devices using the Device drop-down menu.

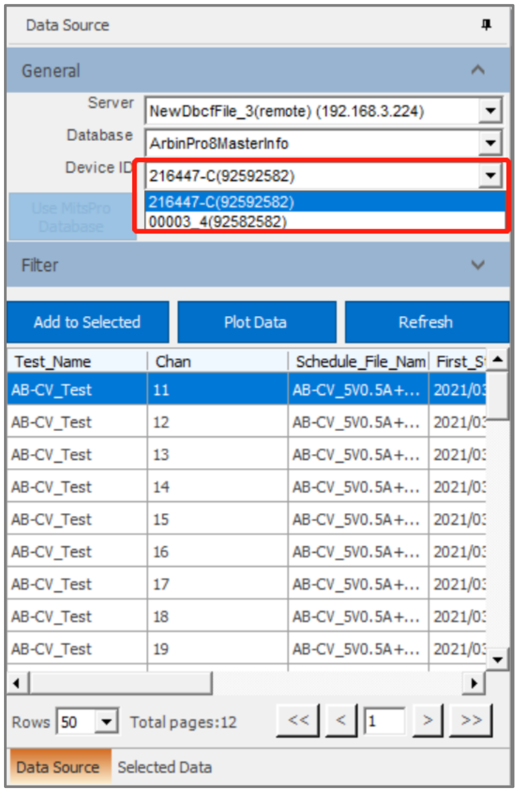


Figure 16-28 Switch Between Devices

16.5 Manage Cloud Database Configuration Settings

This feature is temporarily not supported.

17: Hardware Calibration

17.1 Introduction to Hardware Calibration

The calibration process calibrates the channel DAC and ADC's gain and offsets factors for voltages, currents, and resistances. DAC parameters correspond to the Control Error, which compares the Desired Value and the Accurate Value. ADC parameters correspond to the Measure Error, which compares the Machine Value and the Accurate Value.

For IV channels, DAC and ADC parameters will be calibrated simultaneously. For most Auxiliary channels, only ADC parameters will be calibrated. A digital multimeter (DMM) of at least 6½ digits or greater is required to perform accurately and precisely calibrate. A minimum of three measurement setpoints spread across the range is required for a successful calibration.

After performing the hardware calibration, the system will calculate the appropriate calibration factors. Arbin recommends customers calibrate their Arbin testing equipment once every year.

NOTE: All tests should be stopped, and all channels should be disconnected from cells before performing any calibration!

17.2 Perform a Manual Calibration

There are two ways to start manual calibration.

1) In WinDaq, click on the "Calibration" icon in the toolbar to open the calibration Interface, as shown in Figure 17-1.

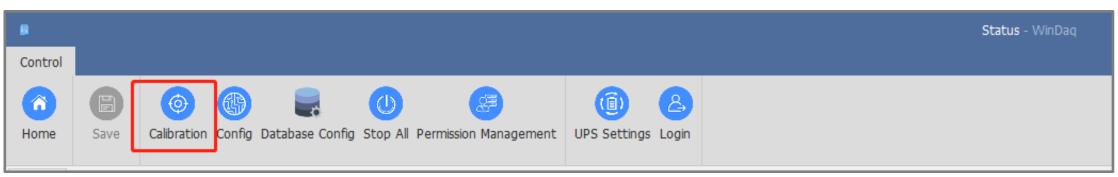


Figure 17-1 Enter the Calibration Screen from WinDaq

2) Second, under the Console application, double-click the "Calibration" icon on the home page to open the calibration screen, as shown in Figure 17-2.

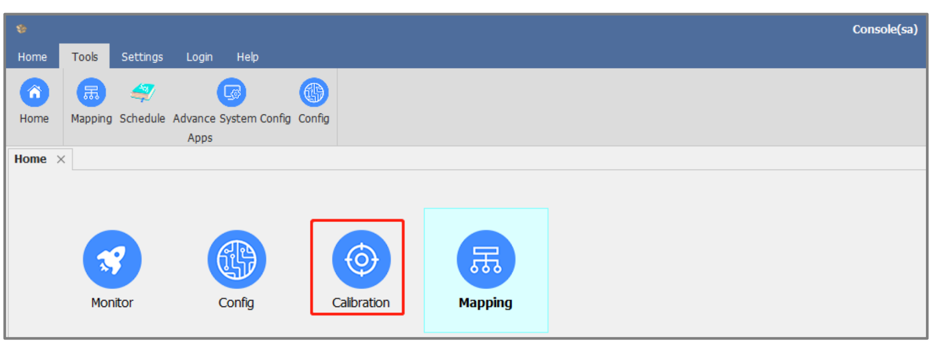


Figure 17-2 Enter the Calibration Screen from the Console

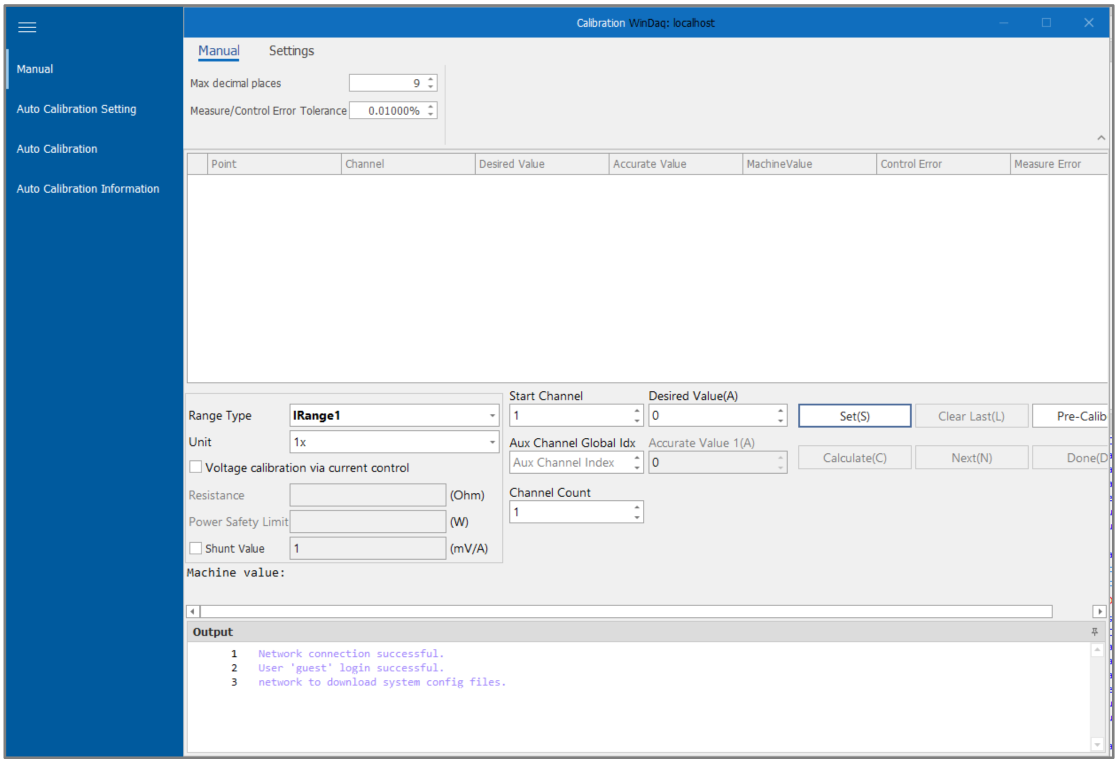


Figure 17-3 Manual Calibration Page

17.2.1 The Manual Calibration Interface

The following sections will describe the meaning of the different elements of the manual calibration Interface.

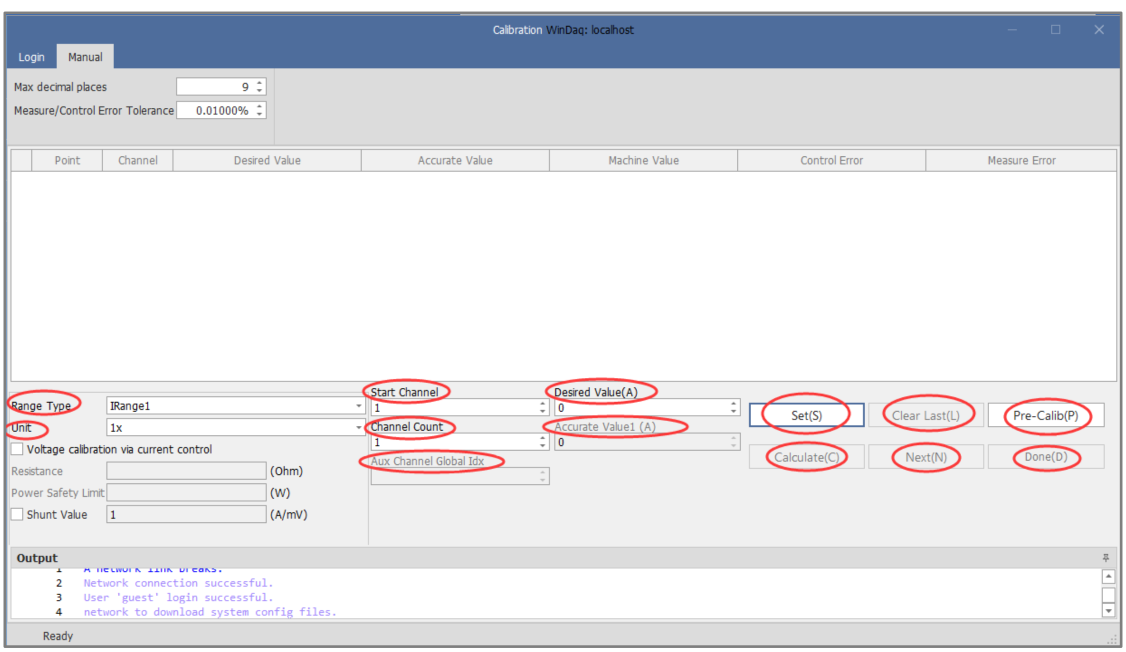


Figure 17-4 Manual Calibration Page Input Section

1) **Range Type** – The default value that appears on opening the Calibration Interface is IRange1(Current-High).
    a) Use the pull-down menu to select the desired type to calibrate.
    b) Even though some types appear on the pull-down menu, they may not be available on your specific machine.
2) **Unit**: The unit of measurement for the Calibration value of the chosen calibration type.
    a) The default value is 1x; choices are 1x, milli and micro.
    b) The values entered into the Desired Value, and Accurate Value fields should correspond to the Units selected.

EXAMPLE: If 1A is desired and the Unit selected is **1x**, 1 should be entered into the "Desired Value" box. If 1A is desired and the unit selected is **milli**, 1000 should be entered into the "Desired Value" box.

3) **Start Channel** – Index of the selected IV channel to check or calibrate.
4) **Aux Channel Global Idx** – This field refers to the physical channel input being calibrated.
    a) The field is available when you choose an auxiliary calibration parameter for Arbin testing equipment with auxiliary channels; it is grayed out for main IV calibration parameters.
    b) The Index selected corresponds to the auxiliary channel Index of the auxiliary page in the file ArbinSys.cfg.
5) **Channel Count** – This field selects the number of calibrated channels at one time.
    a) Channel Count is usually left at 1, as only one channel can be calibrated at a time.
    b) The calibration screen is also used to troubleshoot the communication and manipulated to facilitate turning on multiple channels for troubleshooting.
6) **Desired Value** – This field is used to enter the selected target output value for the calibration process.
    a) The value entered is directly related to the units selected.
7) **Set** – This button is to turn on the channel and initialize the output **(Desired Value)**.
    a) Clicking this button turns the channel on and creates a calibration point.
8) **Accurate value** – This is the field used to enter the value reading from the appropriate digital multimeter (DMM) to perform the calibration.
    a) This field will be grayed out until the "Set" button is clicked.
9) **Calculate** – Clicking this button will generate a **Machine Value** and compares it to the DMM. Then, calculates the **Control Error** and **Measure Error** for IV channel calibration.
    a) This button is clicked after the DMM value is entered into the "Accurate value" box.
10) **Clear Last** – This button cleans the last calibration point. It removes the data points that may have incorrect entries (such as an incorrect sign) without disturbing the previously generated data.
11) **Next** – This button turns off the calibrated channel without saving or altering the existing stored calibration data. It is used when verifying the calibration or abort the calibration process for that channel/parameter.
    a) When this button is clicked, all calibration data points will disappear.

12) **Pre-calib** – This button is used to reset the present calibration parameters of this channel to default in the ArbinSys.cfg file. It only affects the factors of the selected calibration type.
    a) When clicked, a warning Interface will come up, which allows you to abort the process.
    b) This button should not be used except in particular circumstances include: calibrating a new replaced channel or when the normal calibration process is unsuccessful.
13) **Done** – This button saves the calibration data calculated from the displayed calibration point.
    a) The button is grayed out until at least two data points have been generated.
    b) A warning will appear before changing the calibration factors in ArbinSys.cfg, which allows you to abort the process if desired.
14) **Point** –– This column indicates which data point has been generated starting from 1.
15) **Channel** – This column contains the channel number of the calibrated channels.
    a) When calibrating the auxiliary index, this column will contain the auxiliary channel number of the file ArbinSys.cfg.
16) **Desired Value** – This column displays the value that was entered into the "**Desired Value**" box.
17) **Accurate Value** – This column displays the value typed in by the operator from the observed value on the DMM.
18) **Machine Value** – This column displays the value that was measured by the channel of the Arbin machine.
19) **Control Erro**r – This column displays the calculated accuracy percentage based on the **Desired Value** and **Accurate Value**.
20) **Measure Error** – This column displays the calculated accuracy percentage based on the **Machine Value** and **Accurate Value**.
21) **Control Error** and **Measure Error** – Values are only generated for the main IV channel. No values are generated in these columns for the auxiliary channel.

17.2.2 Prepare for Calibration

The following procedures go into more specific detail in how to perform a manual calibration for main IV channels, auxiliary voltage channels, auxiliary temperature channels, and auxiliary external charging current channels. Please read the following chapters for additional details before attempting the calibration process.

Before Calibration

1) Before manual calibration, save a copy of the system file including the original calibration data in ArbinSys.cfg (located in the C:\ArbinSoftware\MITSX directory).
    a) The original system files should be saved somewhere outside the ArbinSoftware folder as a backup.
2) When calibrating an auxiliary channel, input the auxiliary channel Index to match the auxiliary channel Index set on the Auxiliary page of the ArbinSys.cfg file.

a) The calibration of the auxiliary channel has nothing to do with the IV channels. Instead, it relates to the mapping between the auxiliary channel and the IV channel only.

17.2.3 Calibrate Your Hardware

1) To start manual calibration, please click the “Calibration” icon to enter the calibration screen using one of the methods shown in Figure 17-1 or Figure 17-2.
2) Select the calibration type you want to perform from the pull-down menu.
3) Ensure the channel's hardware is correctly connected using the appointed diagram. For the IV channel, please refer to the IV channel calibration record sheet and diagrams in section **17.3.2 Connection Diagrams**.
4) Select the scale in a unit you prefer from the "Unit" pull-down menu. There are three options available to choose, "1x, milli or micro."
5) For IV channel calibration, enter the IV channel number to be calibrated in the "Start Channel" field.
6) For auxiliary channel calibration, input the auxiliary channel index you want to perform in the "Aux Global Channel Idx" field.
7) In the “Channel Count” field, set the number of subsequent channels you want to output at the same time. The maximum number is 8, which is only used for troubleshooting.
8) "Pre-Calib" is to reset the present calibration factors of this channel to the default values in the system configuration. Do not click on this option unless you are requested to do so by Arbin Customer Support.
9) For IV channels, input the first point of setting value in "Desired Value". Please refer to the IV channel calibration record sheet for the recommended 3~4 points of setting value.

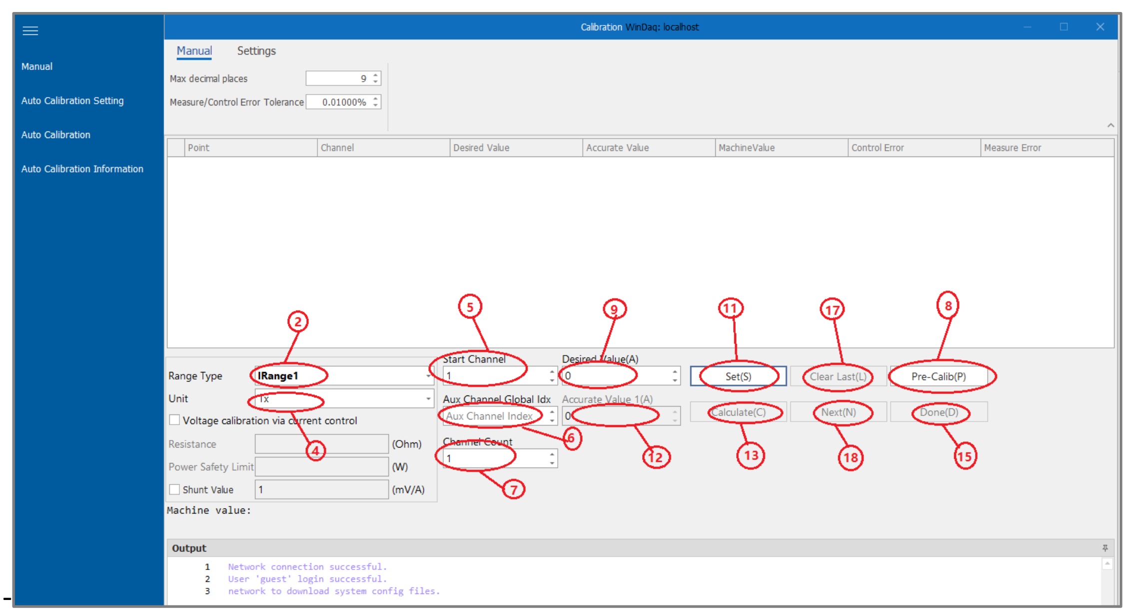


Figure 17-5 Manual Calibration Sequence

10) For the auxiliary channel, only the ADC parameters need to be calibrated.
    a) Adjust the circuitry to make the real measurement close to the recommended values.
    b) Always enter 0 in the "Desired Value" field.
11) Click the "Set" button.
12) In the “Accurate Value” field, Input the measurement value of the calibrated digital multimeter.
13) Click the "Calculate" button.
    a) An accurate value will be loaded into the system, and the machine value will be available in the calibration Interface.
    b) The Control Error and Measure Error will be calculated.
14) Repeat steps 9 to 13 for other calibration points. At least 2 calibration points are required.
15) Click the "Done" button to finish this calibration. The new calculated calibration factors are saved to the Arbin system configuration file.
16) Confirm your calibration.
    a) For IV channels, set the channel maximum range value in the "Desired Value" field, record the accurate value in the "Accurate Value" field.
    b) Click the "Calculate" button to ensure both the control error and measurement error are within the accuracy specifications.
17) Click the "Clear Last" button to clear the last point of the calibration record.
18) Click the "Next" button to turn off the channel and clear all calibration points shown.

17.3 Perform a Main IV Channel Calibration

Main IV channels refer to those that have charge and/or discharge functions on current and voltage. These channels are also referred to as main channels or IV channels to distinguish them from auxiliary channels, which mainly have a measurement function (except digital I/O channels and integrated channels for temperature chambers).

Generally, Current calibration, Voltage calibration, and Clamp Voltage calibration are all related to the IV Channel calibration. DAC and ADC parameters are calibrated simultaneously and are related to the control and measurement of the IV channel.

17.3.1 IV Channel Background Information

Arbin has two standard types of circuitry for IV channels: Linear-Bipolar and PWM.

Arbin has two styles of clamp voltage control: Group-Based and Channel-based. For group-based, the user only calibrates one channel per unit (Micro-Controller). The calibration factors will be applied automatically to other channels in the same unit. The same charge clamps voltage-high value and discharge clamp voltage-high value should be entered at the schedule file and applied to all channels in one unit.

For the channel-based, each channel has its own clamp-voltage calibration factors, which can be calibrated. The voltage clamp function can be applied individually on each channel. Regarding Clamp Voltage, please refer to section **6.4 Configure Settings for the Global Page**.

IV channel can have up to four current ranges. IV channels can have up to two voltage ranges which are Voltage-High and Voltage-Low. If only one voltage range applies, the Voltage-High will be the default.

Clamp voltage ranges should be equivalent to voltage ranges which are Clamp Voltage-High and Clamp Voltage-Low. If only one clamp voltage range applies, the Clamp Voltage-High will be the default. (Please notice Clamp Voltage-High and Clamp Voltage-Low in Calibration Interfaces have different meanings from voltage-clamp high and voltage-clamp low in the schedule file.)

Refer to the IV Channel Calibration Record Sheet attached to the beginning of this manual for additional information.

17.3.2 Connection Diagrams

The following diagrams indicate the IV channel hardware connection for different IV channel calibration conditions. Some devices are required to calibrate, such as a Digital Multimeter (DMM), Precision Shunt, Resistor, Battery, Capacitor, and Cable. Recommendations on connection diagrams, devices, and calibration points are indicated in the IV Channel Calibration Record Sheet for reference.

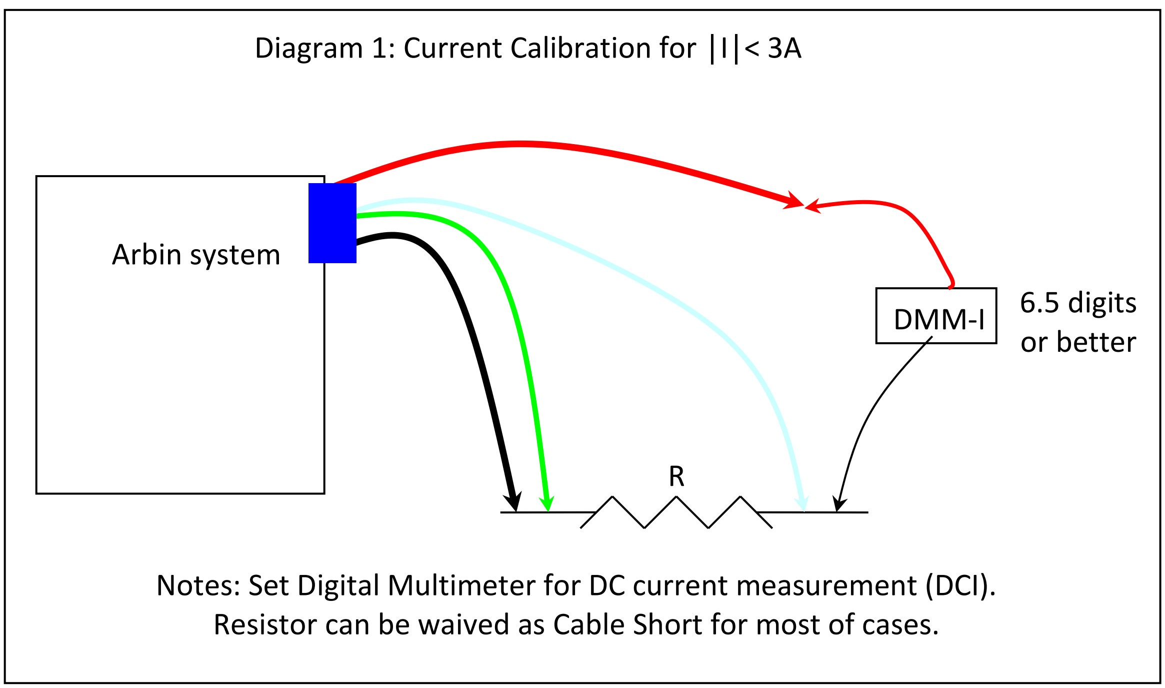


Figure 17-6 Current Calibration for |I|<3A

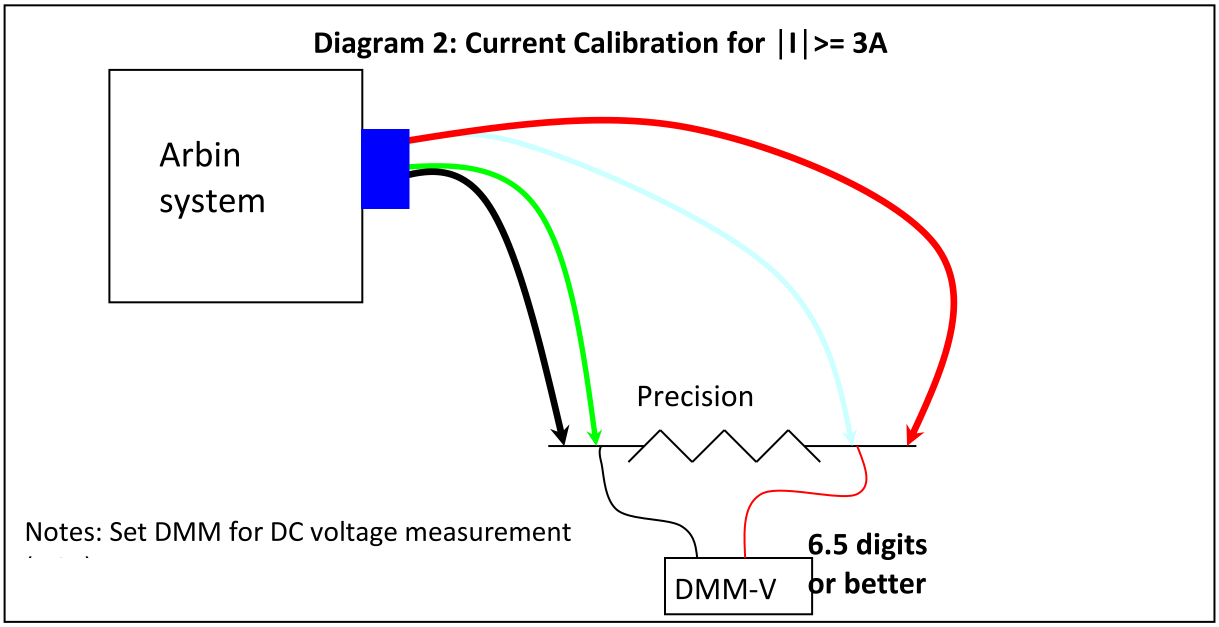


Figure 17-7 Current Calibration for |I|>=3A

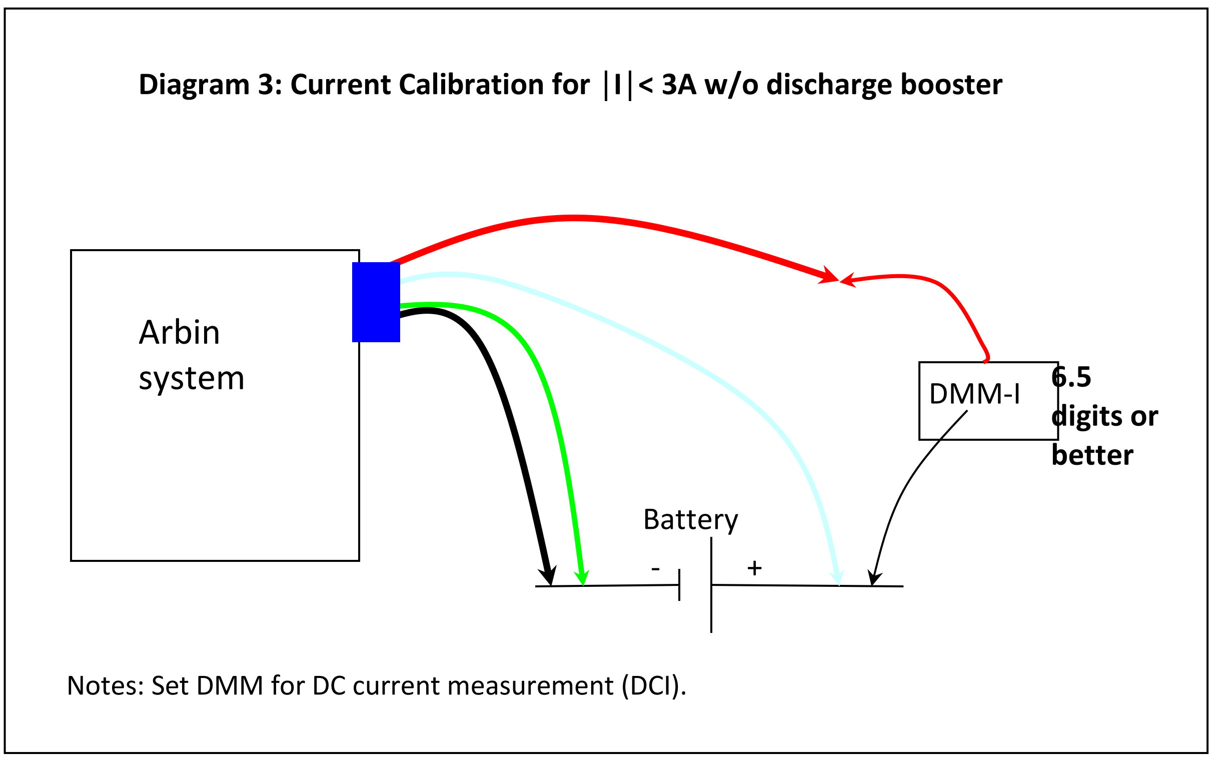
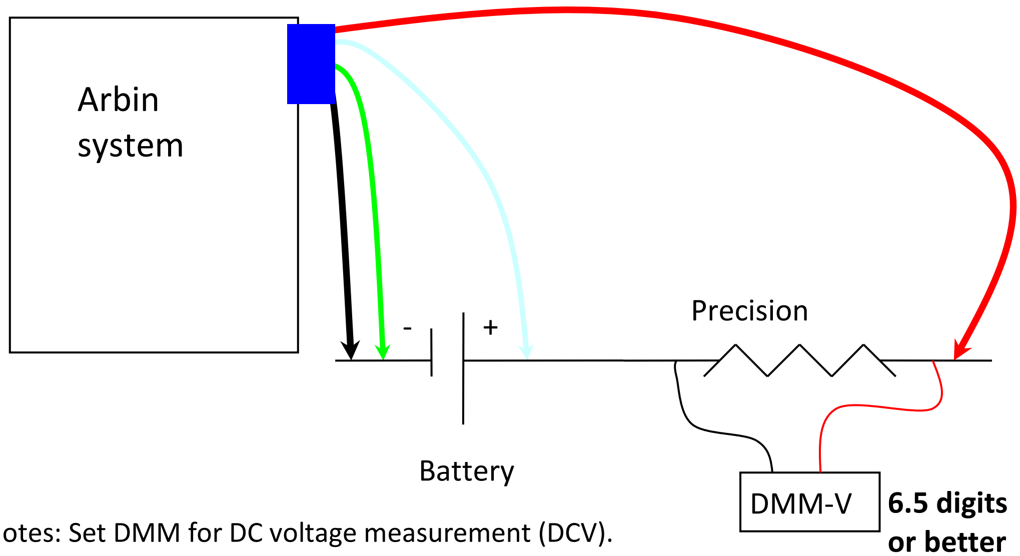


Figure 17-8 Current Calibration for |I|<3A w/o Discharge Booster

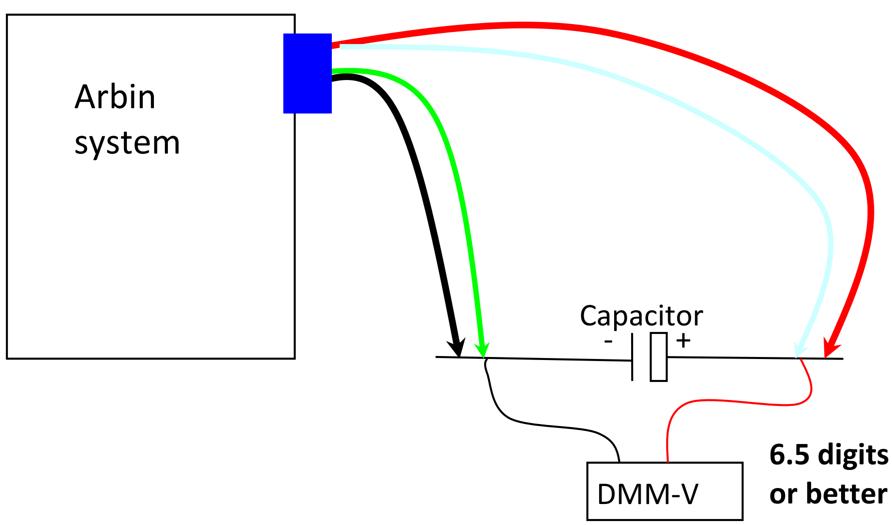
Diagram 4: Current Calibration for |I|>= 3A w/o discharge booster



Notes: Set DMM for DC voltage measurement (DCV).

Figure 17-9 Current Calibration for |I|>=3A w/o Discharge Booster

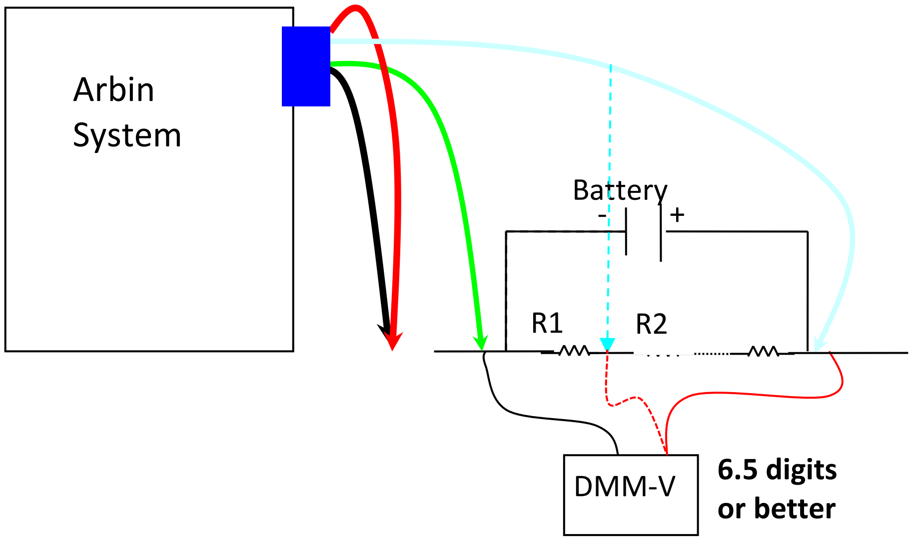
Diagram 5: PWM Voltage or Clamp Voltage Calibration



Notes: Set DMM for DC voltage measurement (DCV). Some systems require a capacitor to stabilize voltage output for clamp voltage calibration. **Warning:** When a capacitor is used, voltage **MUST NOT** be set to less than 0V. Otherwise, the capacitor may explode because of reverse voltage input. Correct polarity must be observed.

Figure 17-10 PWM Voltage or Clamp Voltage Calibration

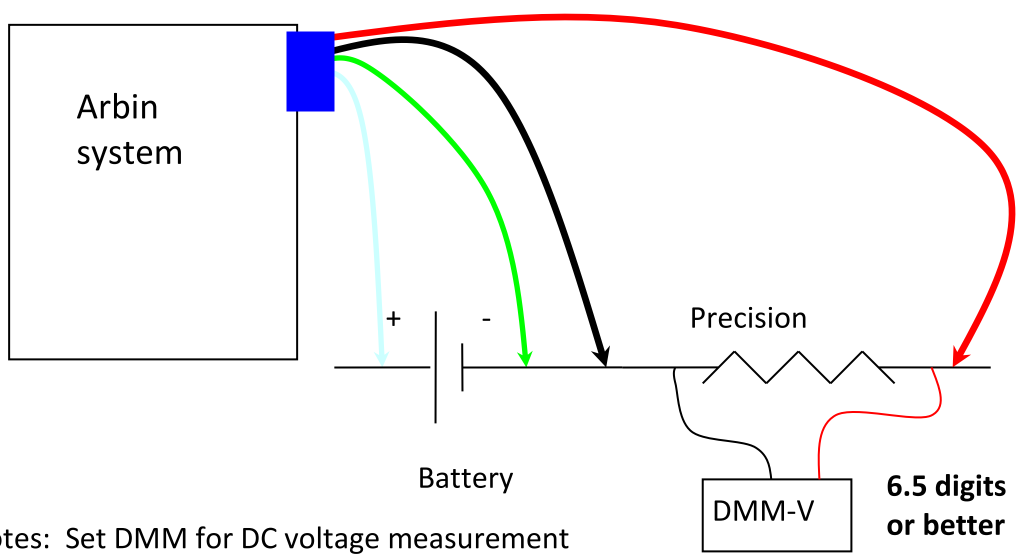
Diagram 6: Voltage or Clamp Voltage Calibration



Notes: Diagram 6 is an alternative method to the Diagram 5 Voltage calibration. Set DMM for DC voltage measurement (DCV). One or more batteries can be used to be the source of DC voltage. Single or multiple resistors are either in series or parallel connections to generate different voltage readings for calibration.

Figure 17-11 Voltage or Clamp Voltage Calibration

Diagram 7: Current Calibration for |I|>= 3A with discharge booster



Notes: Set DMM for DC voltage measurement

Figure 17-12 Current Calibration for |I|>=3A with Discharge Booster

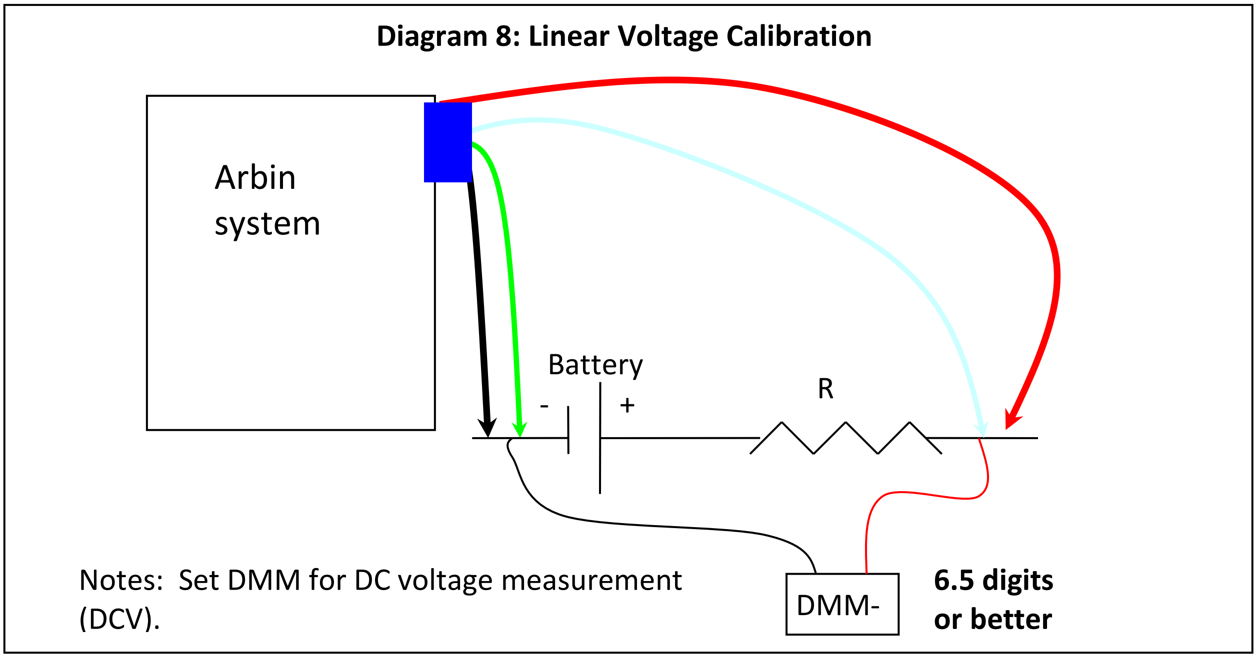


Figure 17-13 Linear Voltage Calibration

Figure 17-11 and Figure 17-13 are two different approaches to calibrate voltage. Figure 17-11 uses resistors to calibrate the voltage. Figure 17-13 uses the battery as a DC power source.

In Mits X software, there are two control methods: Digital Control and Analog Control. The digital control option is pre-set in the ArbinSys configuration file by Arbin (see Figure 17-14 below). If the Digital Control is checked in the ArbinAdvSys.cfg file, Arbin recommends using the layout in Figure 17-13 for voltage calibration to avoid potential oscillation of voltage reading.

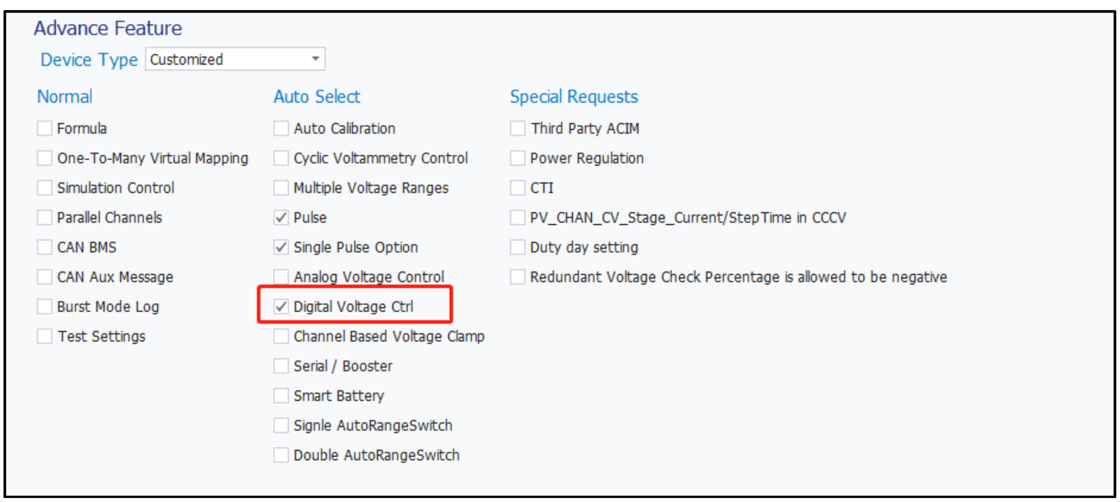


Figure 17-14 Digital Control Option in the System Configuration File

18: Hardware Technical Overview

DISCLAIMER: This chapter attempts to describe all possible configurations of the LBT series of research instruments. Some configurations and features covered in this overview may not apply to your particular battery testing equipment or system. Please refer to the Arbin sales order and system specification sheet for the actual system specifications.

The LBT series system is a full-featured test system specially designed to research and develop batteries with various chemical compositions. It is designed to provide flexible control, comprehensive functions, smooth transition of control methods, preventive safety, and system reliability. In addition, it provides individual control for each constant potential/constant current channel.

NOTE: Equipment repair and maintenance must be performed by authorized Arbin personnel.

18.1 Hardware Structure

18.1.1 General System Components

The LBT series testers are based on a modular design; the basic, individual components are used to build a complete chassis. Basic components include DC control power supply, IV channel board, charging/discharging power supply, controller PC, and auxiliary components. LBT series testers use a series of static IP addresses to communicate through standard TCP/IP communication protocols. LBT series hardware can be roughly divided into low-power, medium-power, or high-power based on the output power of the IV channel of the system.

DC Control Power Supply Components
The DC control power supply assembly is used to power on and off the main Arbin chassis. It usually includes a green on/off switch and an EMO (emergency machine off) switch. In addition to opening and closing the Arbin case, this component also provides control power for the IV channel control circuit.

IV Channel Board
The IV channel board is used to adjust the current/voltage between the Arbin tester and the device under test through software control. Low-power IV channel boards usually have more than one controllable channel per board, and the charge/discharge power supply can be part of the board assembly.

Each low-power board can have 1/2/4/8/16 channels. Each circuit board will have one or more microcontrollers (units). Medium-power boards usually have 1 or 2 channels per board and 1 microcontroller per board. High-power boards will have one channel per board or create a channel from multiple boards.

Charge/Discharge Power Supply Components
All Arbin testers have some combination of charging/discharging power supply units. These power supply units are used between the IV channel and the device under test (DUT). The charging power supply provides a charging current to the device under test, and the discharging power supply provides discharge current to the device under test.

The number of charge and discharge power supplies used in the chassis depends on many variables, such as equipment power requirements, the number of IV channels, the power of each channel, and other variables based on the engineering design and established at the point of sale.

Controller PC
The responsibility of the controller PC is to establish an interface between the end-user and the Arbin tester through the MITS Pro software. The controller PC is used to write test procedures, run tests and perform data analysis. Although most of the controlling of running tests has been transferred to the microcontroller level, the controller PC still needs a full-time connection with the battery tester to make it work properly.

Auxiliary/Accessory Components
The LBT series provides a variety of auxiliary options. The auxiliary channel is selected according to the customer's test requirements. Arbin has some auxiliary channels designed together with IV channels, while other auxiliary options are provided by auxiliary boxes outside the main Arbin chassis. According to the auxiliary options selected at the time of purchase, auxiliary components can be configured in a variety of ways. Please refer to the sales documentation for the available auxiliary options.

18.1.2 Low-Power Systems

In low-power systems, a module usually contains multiple IV channels with a charge/discharge power supply to supply power for all IV channels. Each module can have one or more microcontrollers. The number of microcontrollers can be adjusted according to test needs. Pulse and simulation testing will require more microcontrollers per module, while battery cycle testing can be done with one microcontroller per module.

An example of a low-power module is shown in Figure 18-1. As can be seen from the figure, the DC control power supply, IV channel module, and Change/discharge power supply are integrated in one component.

Figure 18-1 Low-Power System

For systems that require more IV channels, the low-power components can be installed in a larger chassis. In this configuration, each component will be connected to a DC control power supply, which is used to turn all components on and off with a green power switch. In some cases, depending on the overall equipment power requirements, larger enclosures may have additional AC circuits such as circuit breakers, contactors, and additional wiring to provide AC power to each component.

The communication network is usually connected to the outside of the main box assembly. Figure 18-2 is an example of low-power components installed in a large chassis with a DC controller power supply and a hub for communication between all power components.

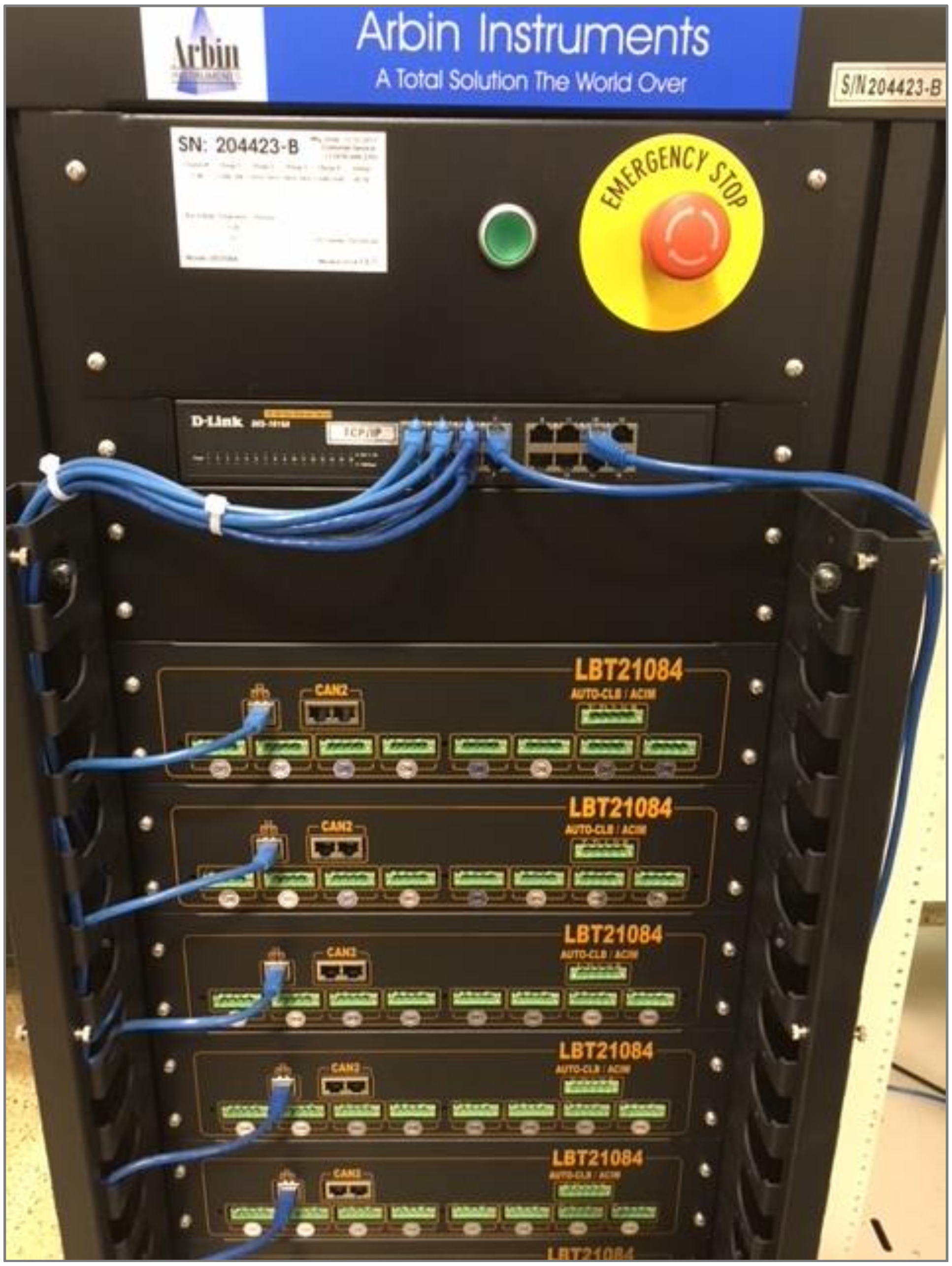


Figure 18-2 Low-Power Systems in Larger Chassis

18.1.3 Medium-Power Systems

Medium-power systems usually have 1 to 8 IV channels per module. Each module usually has 1 microcontroller. The DC control power supply and the charge/discharge power supply are separated from the IV channel module for medium power systems.

Depending on the specifications, the structure of the entire system can have one charge/discharge power supply to multiple IV channel modules or one IV channel module. In most cases, only one DC control power supply is used to power and cut off the entire system through the green power switch. Figure 18-3 is an example of a medium power system.

Figure 18-3 Medium Power System

Figure 18-3 shows each IV channel module has a dedicated charging and discharging power supply. The charging and discharging power supply has protective circuit breakers on each component due to the high power.

In addition, the system has a DC control power supply for opening/closing the Arbin case. The TCP/IP communication cable and hub have been relocated inside the main box in this configuration. The upper left panel consists of TCP/IP network ports, used to connect the controller PC and any auxiliary chassis that may be part of the system.

Figure 18-4 Medium-Power Chassis

Figure 18-4 shows an example of a medium-power chassis. Each IV module has 8 channels, and the same charging and discharging power components are used for 2 IV channel modules. A total of 16 IV channels use one charge and discharge power supply. The Arbin system has a DC control power supply, which is used to turn on/off the chassis through the green power switch. In this example, TCP/IP communication is connected to the Arbin chassis through a hub externally.

18.1.4 High-Power Systems

High-power systems can be composed of linear circuits or pulse width modulation circuits. Linear circuits usually use a series of MOSFETs as the power regulation circuit between the Arbin system and the DUT. The MOSFET dissipates unused power through heat.

For high-power systems, the use of linear circuits will generate a lot of heat. Pulse width modulation (PWM) technology uses the advantages of IGBTs to convert unused energy back to AC power and feed it back to your AC power grid.

Over the years, the design of high-power systems has adopted complex linear circuit designs. Due to the new IGBT technology, more high-power systems have been used in pulse width modulation technology. The high-power Arbin system is more complex in design but still uses the same basic system components.

Most high-power systems have a small number of channels per chassis, and one or more IV boards are connected in parallel to build a single high-power channel. Depending on the function purchased, the IV channel will have one or more microcontroller boards.


Figure 18-5 Dual-Channel PWM Chassis

Figure 18-5 shows an example of a dual-channel PWM chassis. Each PWM chassis will have different charging and discharging power supply design according to system and facility requirements. The PWM system uses an internal TCP/IP communication structure, and the hub is located in the main box. The communication port connects the controller PC to the system and auxiliary channels, depending on the option selection.

18.1.5 Connection Modes

The Arbin system uses various types of Phoenix connectors, lugs, and twist-lock connectors to connect different IV channels and DUTs. ARBIN also provides customized cable solutions to meet testing needs. The cable length varies from 6 feet to longer, but we recommend using the shortest possible cable to meet the test needs. Longer cables will pick up noise and may reduce the Arbin system's ability to control current accurately. The voltage drop that occurs with long cables will also require the Arbin tester to provide a higher voltage to meet the voltage requirements.

Typical low-power systems use Phoenix connectors as the IV channel cable connection method. According to the rated current of the low-power IV channel board, different Phoenix connectors are used. Typical connectors are 10A, 20A, and 50A connectors. Low-power systems can use alligator clips, ring terminals, or bare wire cables according to customer needs.

Medium-power systems will use Phoenix connectors or cable lugs according to current requirements. These cables are usually terminated with larger alligator clips or lugs. High-power systems usually use twist-lock connectors to connect to the IV channel and lug terminals. The manufacture of high-power cables is as short as possible to meet customer test requirements.

All Arbin IV channel cables will be connected to the DUT using the 4-wires method regardless of their rated power. Two smaller cables are used to measure voltage with various colors. The standard color of the voltage cable is white (V+) connected to the battery's positive terminal, and green (V-) connected to the battery's negative terminal.

Two thicker cables are used to transmit charge and discharge current. The current cable is usually red (I+) connected to the battery's positive terminal, and black (I-) connected to the battery's negative terminal. This type of connection is usually called a 4-point Kelvin connection.

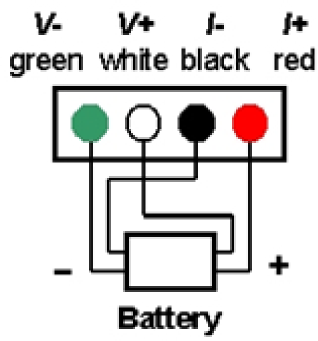


Figure 18-6 4-Point Kelvin Connection

Figure 18-6 shows an example of a 4-point Kelvin connection between low-power IV channel and battery. Generally speaking, the best connection method is connecting the voltage lead as close to the battery terminal as possible and connecting the current lead. However, it is important to note that connecting to the battery in any other way may or may not cause problems with Arbin's current/voltage control circuit.

18.1.6 Power Supply

The newer LBT tester is designed to use two basic power supplies: a DC control power supply and a charging and discharging power supply. The DC control power supply is to switch on the main Arbin chassis. The input voltage range of the DC control power supply is usually 90 to 230 VAC.

The output of the DC control power supply is usually a 24V DC signal, which is used to supply power to the IV channel board components and to provide a 24V DC connection signal to the charging and discharging power supply. The DC control power supply is identified by the green power switch and EMO (emergency machine shutdown) switch on the front panel. In the most common configuration, the Arbin system will have 1 DC control power supply.

Arbin designs the main charging and discharging power supply components. There are many different configurations of charging and discharging power supply components. The factors that determine the components used in the Arbin system include facility AC power requirements, total IV channel power requirements, and other variables.

The AC input voltage can range from 110V/220V single-phase to various three-phase voltages. Regardless of the AC input voltage and DC output voltage, the main purpose of the power assembly is the same. The charging and discharging power supply assembly provides charging and discharging current to the test device through the regulating circuit (IV channel).

The same power supply can be used as the power supply for one or more IV channels. The standard charge/discharge power supply will have an input voltage/current rating and then provide output voltage and maximum current ratings for the charge and discharge power supply. In the chassis assembly engineering stage, engineers will connect as many IV channel board components as possible as long as they do not exceed the charging/discharging power supply rating.

18.1.7 Fuse and Circuit Breaker

The DC control power supply is generally fused at the AC input terminal. The input terminal has a repairable fuse, which can be replaced in case of an overcurrent.

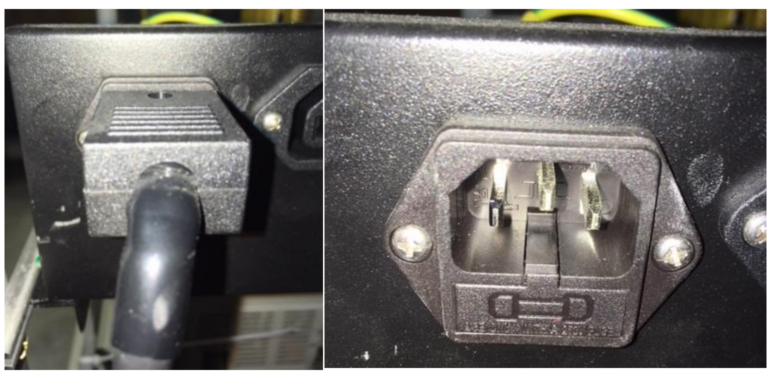


Figure 18-7 Typical Fuse Locations for DC Control Power Supplies

Figure 18-7 shows typical fuse locations for DC control power supplies. The plastic part showing the fuse symbol can be removed to access the fuse. Depending on the Arbin chassis configuration, the fuse rating varies. Use the existing fuse as a rating reference to ensure that a correct fuse is used for replacement.

The charge/discharge power supply assembly will have many different over-current protection combinations. Most power components have circuit breakers to protect individual components from overcurrent conditions. There may be a larger system-level circuit breaker/contactor circuit in larger systems consisting of more than one power assembly as additional current protection. It is important to follow the Arbin recommended circuit breaker/power derating for the equipment protection circuit.

The LBT series testers do not have repairable fuses suitable for low-power IV channel board assemblies. In some cases, low, medium, and higher power systems will have a protective fuse installed near the front of the IV channel board. For more information about the fuse location and replacement procedure of the IV channel board assembly, please contact Arbin Customer Support.

18.1.8 Cabinet Ventilation

All Arbin test equipment is air-cooled. Proper airflow is essential to ensure that equipment meets the published performance specifications. Side-to-side airflow is used for low-power systems; front and back airflow are used for medium-power and high-power systems. All systems are composed of a fan assembly, and the fan assembly will adjust the fan speed according to the calculated power used during the test. The IV channel will stop if the Arbin software detects that the temperature is too high, or the fan is damaged.

WARNING: Operating Arbin equipment outside the recommended environment may cause negative effects on system performance, increase calibration frequency requirements, and shorten the life of electronic components.

The equipment is suitable for the following environmental conditions:

- Usage: (Indoor)
- Altitude: (3,000m)
- Temperature: (10°C to 35°C)

Maximum relative humidity: When the temperature is as high as 31°C, it is 80%, and when the temperature is 40°C, it decreases linearly to 50%. Non-condensing.

18.2 Electrical Connections

18.2.1 System Connections

Arbin LBT series testers have a wide range of AC power connection schemes. For specific power requirements, please refer to the specific Arbin serial number in the production record. New system orders will provide AC power information during the sales process.

Channel Connection and Voltage Symbol Convention
For various proprietary Arbin-Kelvin circuit cell holders (optional), the operator can follow the installation instructions to verify the pinout. Two examples of cell holder connections are Pogo pin probes and lithium polymer flat cell contacts. The Pogo probe is designed to be cylindrical, button, and coin batteries, and contact these batteries individually on two opposite terminals. Similarly, the flat battery holder provides isolated I and V measurements for the foils of lithium polymer and plastic lithium-ion batteries. A "press" label protector will position the battery slices and ensure continuity with the contact pads on the holder.

The symbol convention for all charging and discharging currents is: positive current is used for charging batteries, and negative current is used for discharging batteries. Both white V+ and green V- wires are used for voltage sensors. During calibration, the voltage sign convention has been specified so that the positive voltage with respect to the potential of the green wire terminal locates on the white terminal. For testing batteries using the Arbin system, the red and white wires must be connected to the battery's positive electrode, and the green and black wires must be connected to the battery or the negative electrode of the battery.

Be careful! In terms of electronics, the reverse connection of the voltage leads will not affect the operation of the circuit. However, incorrect voltage readings may immediately terminate the test. Please check the voltage reading on the monitor and control Interface immediately after the test starts. (Note: Using the Rest step to start the Schedule will help with the initial check.) In many cases, if the cable accidentally misconnects to the battery, the correct global safety settings in the schedule will stop the test.

Caveat! Reversing the current lead will damage the battery, and in the worst case, it may cause an explosion or fire in the battery, such as a lithium battery. In this case, the current reading may look normal, but the polarity is reversed. Rechecking the current wire connection is a mandatory step in the operation of the system. In addition, it is important to set the voltage appropriately to prevent potential hazards when the battery or battery chemistry is rechargeable.

18.2.2 Auxiliary Input

Secondary Voltage

The auxiliary voltage input (called secondary voltage) is connected to the test bench using a 4-pin miniature Phoenix connector, and the battery is connected using an alligator clip.

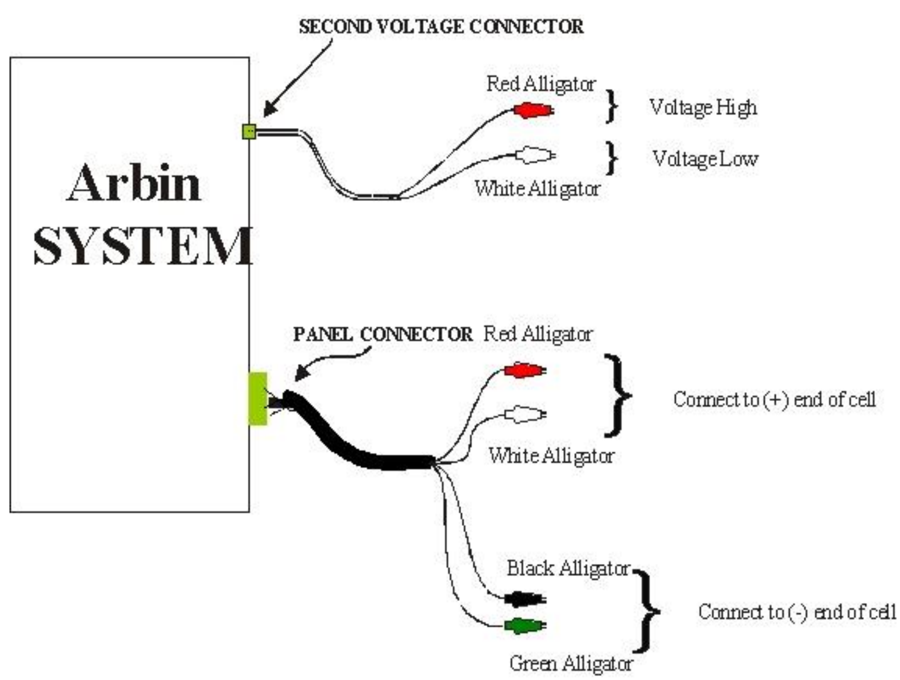


Figure 18-8 Terminal Connections for Battery Testing Using an Arbin System

Figure 18-8 shows the red lead is connected to the high potential or a positive potential. The black lead is connected to the low or negative potential. For three-electrode experiments, the green and white leads or a second voltage input can be used to measure the reference potential.

However, only the potential measured by the green and white lines can be used for voltage control in the potentiostat mode. (The secondary voltage input is only for measurement use: the test bench does not control the voltage measured by the secondary voltage input.) Please consider the following diagram for the configuration of the auxiliary voltage measurement capability of the Arbin system.

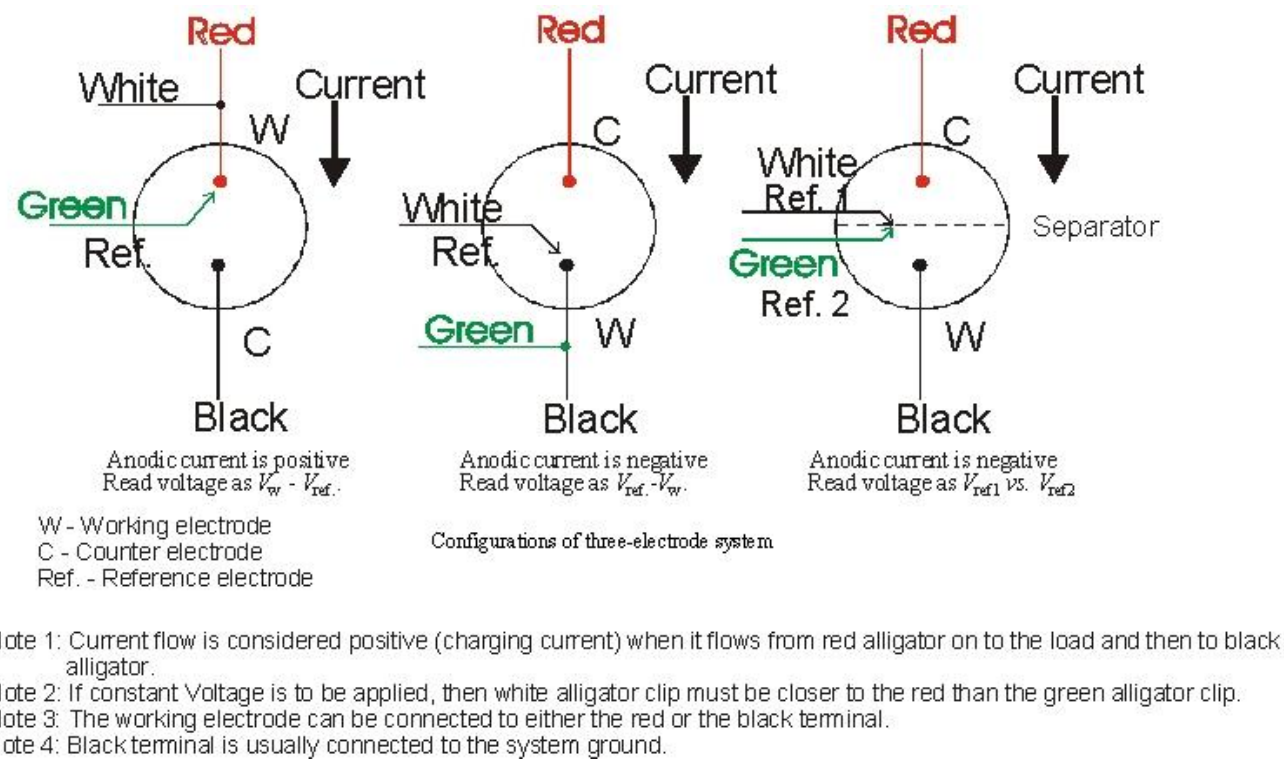


Figure 18-9 Multi-Electrode Connection Diagram

Auxiliary Voltage Range and Common-Mode Voltage

The auxiliary V channel is usually designed to have a differential measurement capability of -10V to +10V. However, another design parameter is the maximum common-mode voltage, which is the maximum potential between the (+) wire and the circuit ground (isolated from the chassis ground). The maximum value is usually ~12V, which represents the basic limit for measuring the maximum potential of any input.

EXAMPLE: The main IV channel of the instrument has a voltage range of 30V and is used to charge 5 lithium chemical battery packs. A separate auxiliary voltage channel monitors each battery pack with a maximum potential of 21V. Suppose you assume that the voltage of each battery pack is 4.2V. In that case, only the correct auxiliary readings will be generated for the first three battery packs (the common-mode voltage of channel 3 is 12.6V). After the fourth channel exceeds the maximum value, it returns to its maximum input voltage ±10V.

The solution: When the common-mode voltage measurement is required to exceed the maximum control voltage of the main IV channel, the user should notify the Arbin design engineers.

Temperature
The thermocouple connection is designed to plug into a thermocouple with SMP mini-jack (available from Omega). The system can be equipped with J, K, E or T-type connectors (user-defined regulations). If the user needs to set the thermistor input, the connection method needs to be defined by the user. The connection interface is a 2-contact miniature Phoenix connector.

18.3 Considerations and Tips

18.3.1 Equipment Considerations

The front and back of the tester should be free of obstructions so that the forced cooling air can flow through the chassis without restriction. Ideally, if adjacent equipment generates a certain amount of heat, a gap of three feet or greater should be provided on each side to ensure that the user has access to the power cord.

However, if the tester seldom runs with all channels running at full power simultaneously, the gap can be reduced appropriately. The gap on both sides of the system should not be less than two feet under all circumstances. The hot air blown from the installed fan may need to be exhausted outdoors to reduce the impact on the room temperature.

When you power on the LBT system, normally, you will hear a few clicks. The cooling fan starts at a higher speed and then decelerates to an idle state. The green power switch will light up for some chassis, indicating that the system is powered on.

18.3.2 Ground Connection Information

The ground connection is very important for the LBT system. AC 3-phase input (electric cabinet grounding) and AC single-phase input must have the same grounding. If the system does not come with a UPS, the grounding of the AC input of the computer must be kept at the same potential as the grounding of the electrical cabinet, especially for testers powered by single-phase AC. Otherwise, the different potentials between the electrical cabinet grounding and the computer grounding may generate current through the grounding wire, which will cause the system to fail. The above ground connection is usually handled through a well-grounded switchboard facility.

Any other devices or accessories controlled by the LBT system (such as an environmental control room) must be grounded at the same potential as the cabinet ground. Before connecting to the LBT system, please check the ground connection of these devices or accessories.

18.3.3 Environmental Considerations

The Arbin system must be installed on a laboratory or factory floor where no other equipment generates dust or harmful chemical vapors, such as graphite powder or corrosive solvents. Chemical vapor or dust may cause damage to the internal circuit and may even cause electric shock. The filter installed on the fan of the tester cannot block fine powder particles or steam.

Caveat! The Arbin limited warranty agreement does not cover system failures caused by the environment. Damages caused by environmental reasons will charge a repair fee, whether completed via on-site or Arbin factory repair.

18.3.4 System Operation Training

Arbin provides paid on-site training, which can be purchased at a discount price when purchasing the instrument, or at a standard price at any time. For more detailed information about on-site training courses, please contact Arbin Customer Service or the Arbin sales department.

18.3.5 Security and Safety

Safety is the primary consideration in the design of the LBT system. In the Arbin battery test or division system, relevant safety mechanisms have been established to protect the system for both battery and users.

Hardware Level: All LBT series boards have a series of hardware-level safety circuits to stop any running tests when the control PC communication is interrupted. The DC control power supply is cut off, and/or the charge and discharge power supply is cut off. In addition, all IV channel board components are designed to protect the MOSFET network in the event of a single component failure in the MOSFET feedback loop and limit the current in the event of a component failure in the current feedback loop. There are many safety check procedures for the PID control of the voltage circuit to stop the test when a voltage control error is detected.

Software Level: Mits X software contains programmable safety settings for power, current, and voltage. These settings can be set at the system level or test level. The low-power LBT system uses a redundant safety voltage circuit independent of the digital voltage circuit to ensure whether the voltage values read by the two circuits are the same. If it is not, the system will stop running the test. Medium-power and high-power systems integrate a low-voltage clamp and high-voltage clamp with a hardware control circuit, which can be used to limit the current/voltage for running tests.

As a part of PID control, digital voltage control now has many new safety considerations. The digital voltage control circuit is used to ramp up the voltage to the control value within a controllable range to reduce the current spikes when switching on and switching between current control and voltage control.

Suppose there is an error in the test programming. In that case, the voltage control circuit can limit the current within 100% of the range to reduce the possibility of damage to the LBT system's hardware Abnormal safety settings can also be used to monitor the comparison of test procedures with current test conditions. If Arbin runs outside the reasonable Interface, the software will stop running the test.

18.3.6 Computer-Tester Communication

The controlling PC communicates with the Arbin hardware through a program called DAQ. When the monitoring Interface starts, the DAQ program will start and minimize automatically. Communication errors will be reported in the DAQ program and to the DAQINFOLOG file. If a communication error occurs, an error message will be displayed in the monitoring Interface.

The LBT series testers use a standard TCP/IP communication port with a static IP address. Each microcontroller located on the IV channel board will have an assigned IP address. The communication network of the Arbin tester adopts a general communication scheme. The static IP address of the controlling PC is 196.168.1.100. The IP address of the microcontroller 1 in the Arbin system is 196.168.1.1, the IP address of the microcontroller 2 in the Arbin system is 196.168.1.2, and so on.

The number of microcontrollers and the allocation of IV channels or auxiliary channels can be found in the Arbinsys.cfg file of each LBT system. All communication cables, hubs, and other network equipment are standard equipment that can be purchased on the market. The standard 6-foot cable is provided by Arbin. Depending on the test requirements, a longer cable may need to place the control PC further away from the Arbin tester. For cable length limitations, please refer to the standard TCP/IP communication protocol.

18.3.7 Calibration

The calibration process is used to compensate for the correction factors that occur in two places:

1) Digital-to-analog conversion (DAC) that converts the data input by the user into the voltage and current of the electrical concept of the test system.
2) Analog-to-digital (ADC) Conversion, which converts the internal measurement value output by the device into a digital signal used in the microcontroller.

The correction of the DAC calibrates the error between the expected value and the precise value (see below for definition). ADC correction calibrates the error between the precise value and the machine value. Both sets of correction coefficients are stored in the microcontroller memory and computer system configuration files.

The calibration data can be “uploaded” from the microcontroller memory to the MCusys.cfg file, or “downloaded” from the Arbinsys.cfg file to the microcontroller memory. Storing the calibrated data in two places is helpful for different situations. A common example is if a customer encounters a PC failure. In this case, Arbinsys.cfg needs to be backed up to restore it correctly.

If the latest Arbinsys.cfg file is not available, you can use the older file. When the new PC is connected to the Arbin hardware, you can "upload" the calibration data from Arbin hardware to the older .cfg file, and use the new calibration data Update. At this point, the test can be resumed without recalibrate the LBT tester. If there is a replacement PC, the recovery time is speedy.

The detailed calibration procedure is introduced in **Chapter 17: Hardware Calibration**. The various measurement values and error calculations are defined as follows.

1) **Desired Value (DV)** – The value entered by the user into the computer.
2) **Accurate Value (AV)** – The value produced by the LBT tester, measured by an external instrument.
3) **Machine Value (MV)** – The internal measurement of the LBT tester's own output. The machine value is recorded in the result data.
4) **Control Error** – defined as {[(DV)-(AV)] / FSR} * 100%.
5) **Measurement Error** – defined as {[(MV)-(AV)] /FSR} * 100%.

18.4 Specifications

18.4.1 System Specifications

System specifications vary for low, medium, or high-power systems. Arbin sales representatives can provide a list of standard system specifications.

18.4.2 Software Specifications

The software specifications may vary depending on the system design and purchased features. Arbin sales representatives can provide a list of standard software specifications.

19: Optional Features

19.1 Schedule Migration

19.1.1 What is Schedule Migration?

Schedule Migration provides a convenient way to transfer your Schedule files from MITS Pro8 to Mits X.

19.1.2 Use Schedule Migration

1) Double-click on the Schedule Migration icon on the Console home page to open Schedule Migration (Figure 19-1).

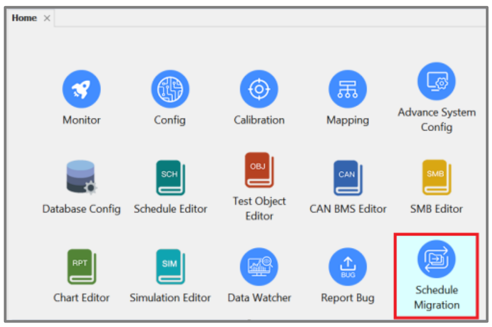


Figure 19-1 Open Schedule Migration

2) Previous/old version Schedule Files will appear on the left side of the Schedule Migration Interface.
3) Click on the "Upload Different Folder Schedules" to select Schedule Files from other locations (as shown in Figure 19-2).
4) Click the checkmark box for the Schedule Files that you want to import.

NOTE: This feature is under development.

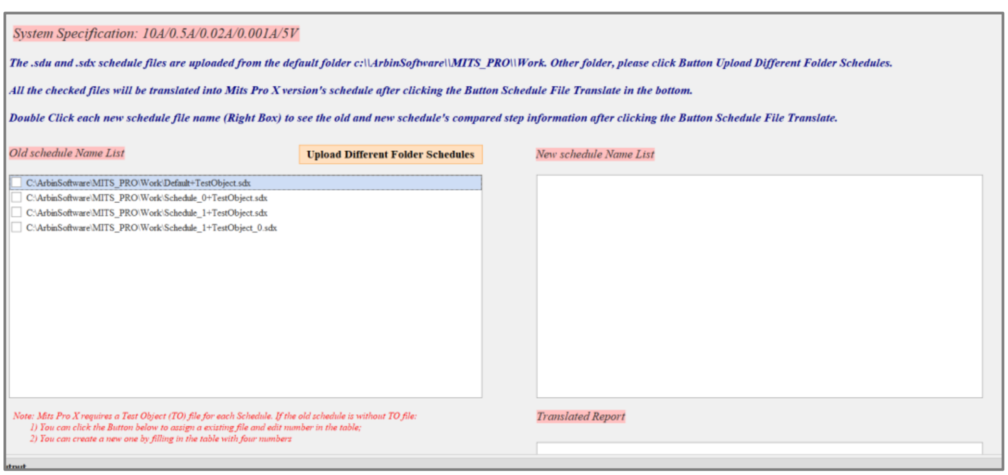


Figure 19-2 Schedule Migration User Interface

19.2 UPS

19.2.1 What is UPS?

Uninterruptible Power Supply (UPS) provides a stable power supply to the PC to ensure that Arbin's equipment can safely stop the channel test in a power outage and continue the channel test after the power is restored.

19.2.2 Use UPS

1) In Config, click on the “UPS Settings” icon to open the “UPS Settings” Interface.

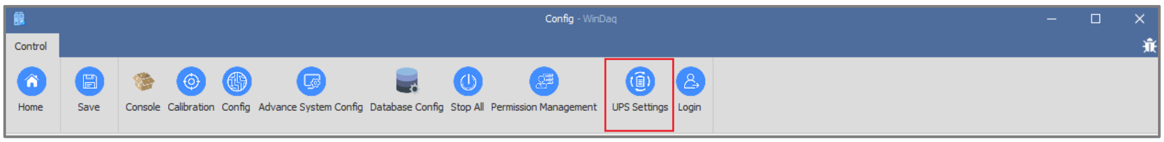


Figure 19-3 UPS Settings

2) Click in the checkmark box next to “Enable UPS” in the UPS Settings to enable this feature.

With UPS enabled, the UPS will communicate with the PC via USB to notify the PC once the power failure is detected. The PC will inform the channel to stop running to prevent test data loss after the PC runs out of power in the UPS.

If the power supply is restored within the set Power Down Threshold Time, you can choose to have the PC notify the channel that just stopped running to resume operation. If the power is not restored after the above Power Down Threshold Time, you can choose to turn off the PC to reduce the power consumption of the UPS. Arbin strongly recommends keeping the default settings for the last three fields, as they are most suitable for Arbin’s major UPS suppliers.

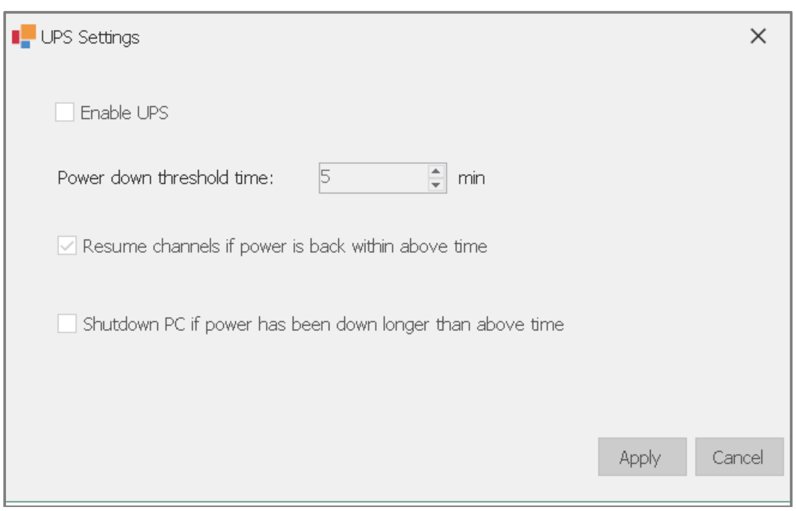


Figure 19-4 UPS Settings Interface

NOTE: Be sure to consider whether the UPS has enough capacity to support the length of time set as the Power Down Threshold Time.

19.3 ACIM/EIS

19.3.1 What is ACIM?

ACIM stands for AC Impedance, which was named in the early electrochemical documents. It is also called EIS, which stands for Electrochemical Impedance Spectroscopy. Impedance measurement was initially a method of frequency response characteristics of linear circuit networks in electricity. However, it has become an experimental method in electrochemical research by citing the study of electrode processes.

19.3.2 Use ACIM

ACIM Basics

Arbin ACIM feature supports both Arbin ACIM board and Gamry equipment.

Arbin sells three different types of Gamry equipment, which are 1010E (replaces the 1000 series), 5000E, and 5000P:

Figure 19-5 Gamry 1010E

A 1010E can perform EIS from 10 µHz to 2 MHz, applying ±12V maximum applied voltage and applying ±1A maximum current with 9 current ranges.

Figure 19-6 Gamry 5000P

A 5000E can perform EIS from 10 µHz to 1 MHz, applying ±6V maximum applied voltage and applying ±5A maximum current with 6 current ranges.

A 5000P can perform EIS from 10 µHz to 20 kHz, applying ±6V maximum applied voltage and applying ±5A maximum current with 6 current ranges.

Connect Power and USB

1) Connect the power cord to the Power In port on the back of Gamry (Figure 19-7).
2) Connect the USB cable to the USB port on the back of Gamry (Figure 19-7).
3) Connect the other end of the USB cable to the USB port on the Arbin PC as the communication connection.

Figure 19-7 Power and USB Port on the Back Panel of Gamry

Connect the Hardware

1) As shown in Figure 19-8, insert the current connector into the front of Gamry.

Figure 19-8 Gamry 1010E with Current Connector

2) Please note that there are six colored plugs: green, red, blue, white, black, and orange (Figure 19-9). The cable pins are as follows:
   a) Green = positive current (I +)
   b) Red = negative current (I-)
   c) Blue = positive voltage (V +)
   d) White = negative voltage (V-)

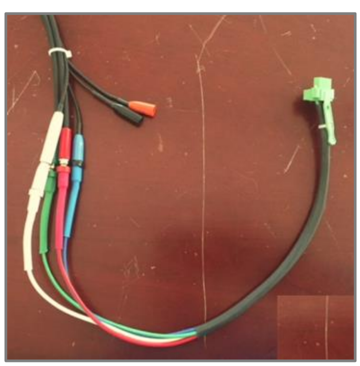


Figure 19-9 Arbin Gamry Cable

3) Connect the Arbin Gamry cable (4-pin ACIM cable) to the corresponding plug of color, as shown in Figure 19-9. Note that the black and orange plugs are not used.

<u>Hardware Connection: 5000E / 5000P Gamry</u>

There is a current connector and a sense connector on the front of the 5000E/500P Gamry, as shown in Figure 19-10 and Figure 19-11.

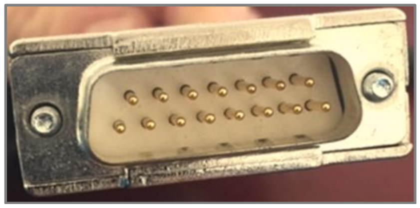


Figure 19-10 Current Connector Plug

Figure 19-11 Sensing Connector Plug

4) Plug both the current connector and sense connector into the front of the Gamry, as shown in Figure 19-12. Please note that the two cables are tied together with cable ties. As shown in Figure 19-12, plug both the current and sense connectors into the front of Gamry.

Figure 19-12 Gamry Connection

   a) The current connector has two plugs (green and red) and the inductive connector has four (blue, white, black, and orange) as shown in Figure 19-13.

Figure 19-13 Gamry Connection with Colored Plugs

5) Next, connect the Arbin Gamry cable (4-pin ACIM cable) to the corresponding plug of color as shown in Figure 19-13. Please note that the black and orange plugs are not used.

Enable/Disable ACIM/EIS
The Arbin ACIM board outputs current and voltage through a 6-pin to 5-pin ACIM cable.

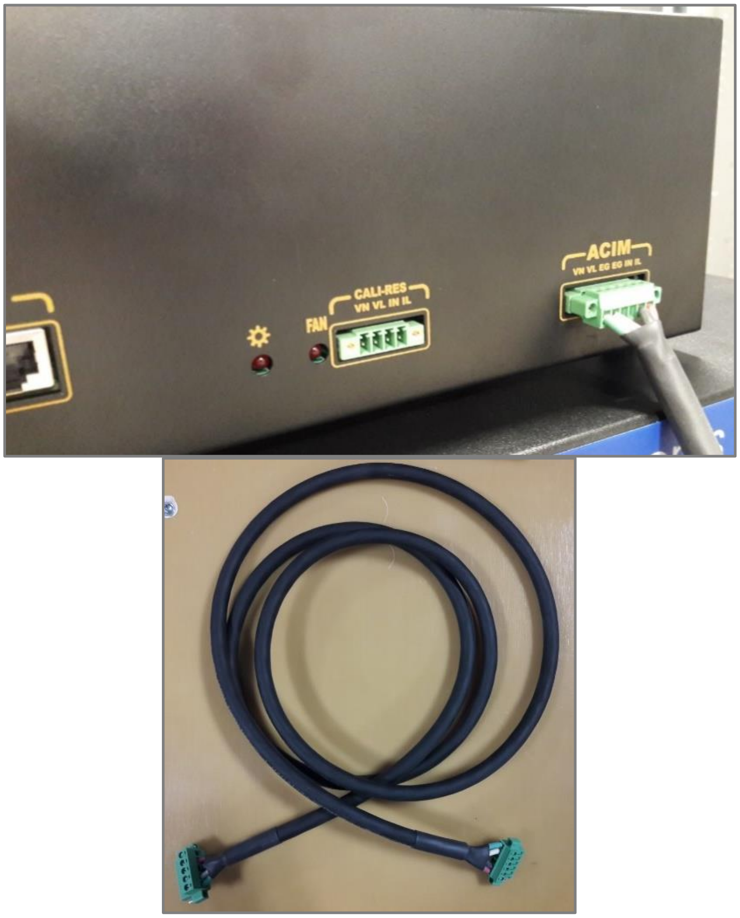


Figure 19-14 ACIM Cable

__Connect the Adapter Cable to the Arbin Tester__
The front of the chassis (one ACIM port on each board).

Figure 19-15 The Ports on the Front of the Arbin Tester Case

1) When connecting the Arbin ACIM/Gamry cable to the ACIM port, it will follow the pin order of V-, V+, I-, I+.
    a) For those ports with a fifth pin ("EG", to be found only in the previous port), this pin is unused and will not affect Gamry's operation.
    b) For chassis with multiple Gamry ports/connections, there is a cable system to daisy-chain on each board so that they can run simultaneously, as in Figure 19-16.

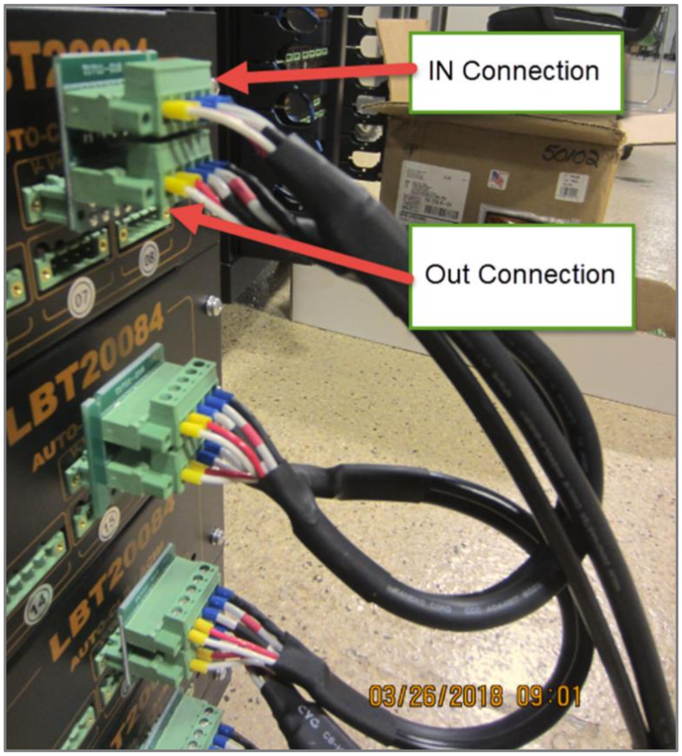


Figure 19-16 Multiple ACIM / Gamry Connection Plugs

2) Each small ACIM/Gamry board has two-five-pin Phoenix connectors, the top connector is used for input connection, and the bottom connector is used for output connection.
    a) There is a 5-pin Phoenix connector at one end of the Arbin current connector cable, which can be plugged into the top/IN connector of the first board.
    b) Next, connect a smaller cable to the bottom/out connector on the first board, and then connect the other end of this cable to the IN connector on the second board.
    c) Repeat a) and b) directly above to set the daisy-chain connection.

Software setting

1) Enable or disable Gamry testing on the "Monitor and Control" screen by clicking the "EIS" icon on the toolbar.
   a) When Gamry testing is disabled, the slider will be red and the slider button will be on the right (Figure 19-17).
   b) When Gamry testing is enabled, the slider will be green and the slider button will be on the left (Figure 19-18).

Figure 19-17 Gamry is Disabled in the "Monitor and Control" Screen

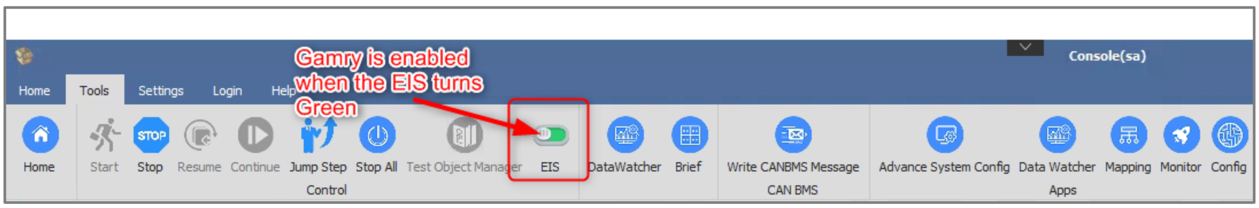


Figure 19-18 Gamry is Enabled in the "Monitor and Control" Screen

Edit the Schedule for ACIM/EIS

1) First, write a small rest step of 5 to 30 seconds long.
2) Insert the ACIM step into the timetable.
3) Insert another small rest step of 5 to 30 seconds after the ACIM step.
4) In the "Control Type" drop-down box, click on the "Pause" option.
5) In the "Control Value" drop-down box, click on the "ACIM" option to view the control parameters.

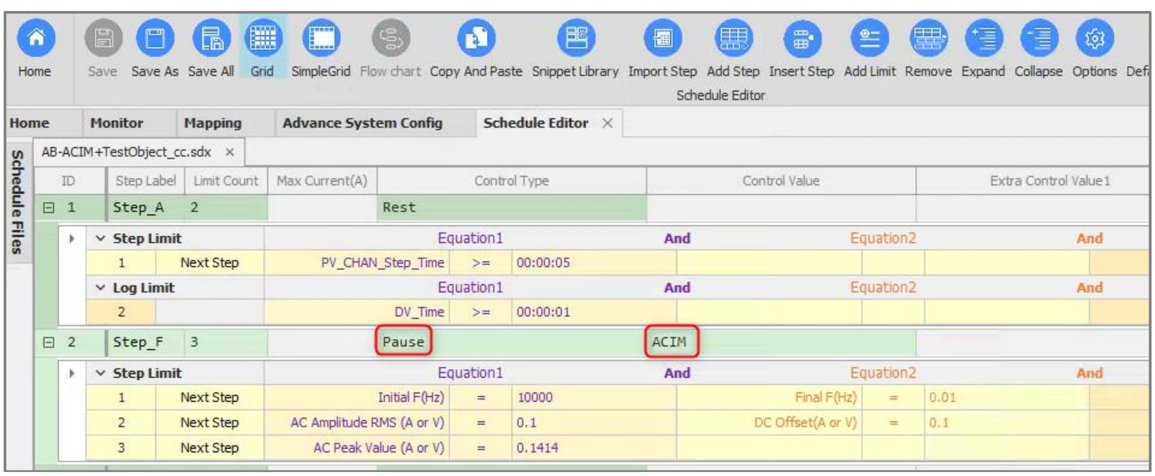


Figure 19-19 ACIM Step

   a) **Initial F(Hz)** – The frequency of initial ACIM test, referred to as IHz.
   b) **Final F(Hz)** – The frequency of the final ACIM test, referred to as FHz.
   c) **Point/Decade** – The number of test points in each decade. Decade= Log (IHz / FHz).

d) **AC Amplitude RMS** – AC voltage or current.
e) **DC Base** – DC voltage or current.
f) **Test Type** – Current Control or Voltage Control.
g) **AC Peak Value** – The peak value of AC voltage or current.

NOTE: To reduce the noise impact on the ACIM loop, Arbin recommends increasing the AC current in the ACIM step. In addition, the ACIM test timetable is limited to (Iac * 1.414 + Idc < Gamry's maximum current).

View ACIM/EIS Data in DataWatcher

1) Open the DataWatcher application to view the ACIM/EIS data.
2) In DataWatcher, you can plot the Gamry data in the EIS Plot box or export the data to Excel.

NOTE: When Gamry testing is in progress, you will not be able to see the data in DataWatcher. However, you will see Gamry data in DataWatcher after the test is complete.

Export ACIM/EIS Data in DataWatcher

1) In DataWatcher, in the Selected Data section click on the "EIS Export" button.

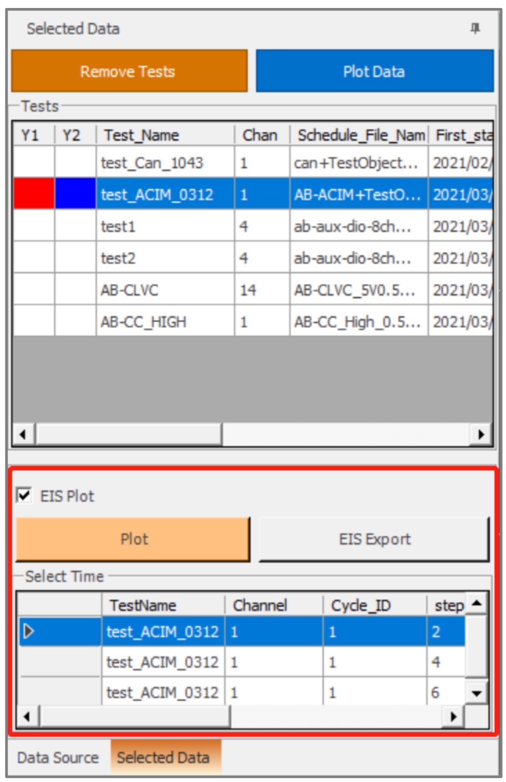
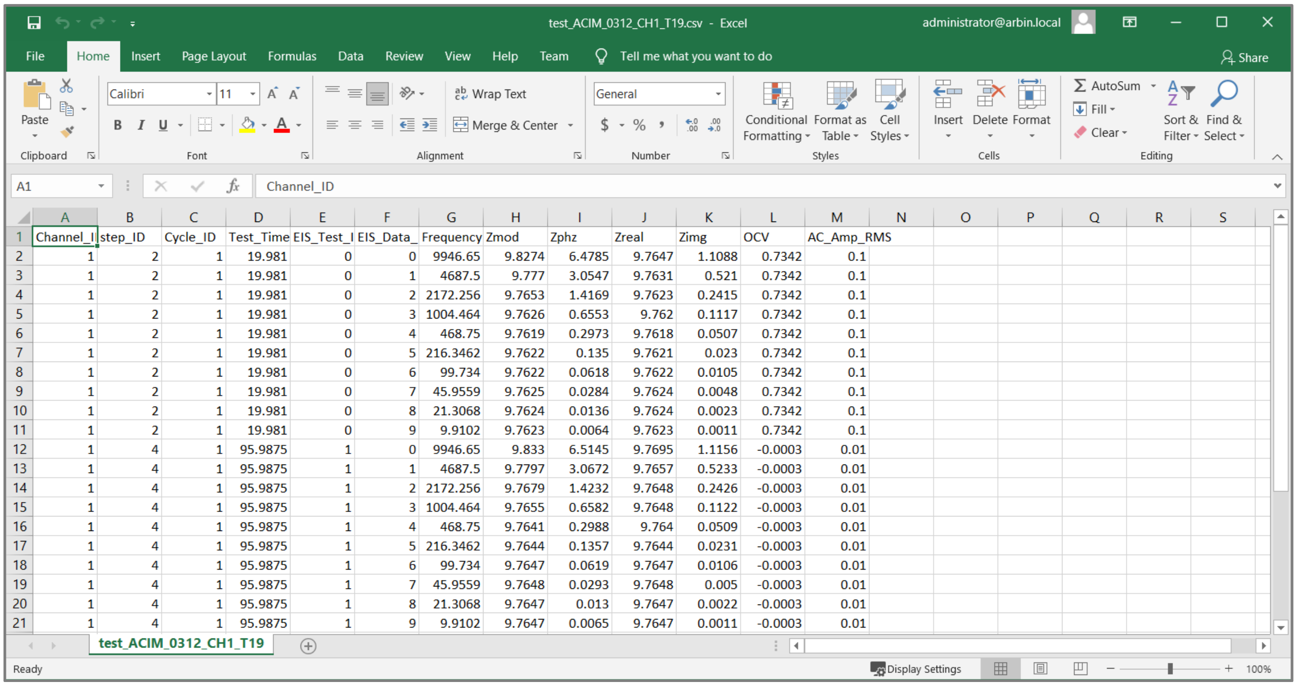


Figure 19-20 DataWatcher Selected Data

2) The ACIM data will be displayed in Excel in CSV format, as shown in Figure 19-21 below.



Channel_I	step_ID	Cycle_ID	Test_Time	EIS_Test_I	EIS_Data_	Frequency	Zmod	Zphz	Zreal	Zimg	OCV	AC_Amp_RMS
1	2	1	19.981	0	0	9946.65	9.8274	6.4785	9.7647	1.1088	0.7342	0.1
1	2	1	19.981	0	1	4687.5	9.777	3.0547	9.7631	0.521	0.7342	0.1
1	2	1	19.981	0	2	2172.256	9.7653	1.4169	9.7623	0.2415	0.7342	0.1
1	2	1	19.981	0	3	1004.464	9.7626	0.6553	9.762	0.1117	0.7342	0.1
1	2	1	19.981	0	4	468.75	9.7619	0.2973	9.7618	0.0507	0.7342	0.1
1	2	1	19.981	0	5	216.3462	9.7622	0.135	9.7621	0.023	0.7342	0.1
1	2	1	19.981	0	6	99.734	9.7622	0.0618	9.7622	0.0105	0.7342	0.1
1	2	1	19.981	0	7	45.9559	9.7625	0.0284	9.7624	0.0048	0.7342	0.1
1	2	1	19.981	0	8	21.3068	9.7624	0.0136	9.7624	0.0023	0.7342	0.1
1	2	1	19.981	0	9	9.9102	9.7623	0.0064	9.7623	0.0011	0.7342	0.1
1	4	1	95.9875	1	0	9946.65	9.833	6.5145	9.7695	1.1156	-0.0003	0.01
1	4	1	95.9875	1	1	4687.5	9.7797	3.0672	9.7657	0.5233	-0.0003	0.01
1	4	1	95.9875	1	2	2172.256	9.7679	1.4232	9.7648	0.2426	-0.0003	0.01
1	4	1	95.9875	1	3	1004.464	9.7655	0.6582	9.7648	0.1122	-0.0003	0.01
1	4	1	95.9875	1	4	468.75	9.7641	0.2988	9.764	0.0509	-0.0003	0.01
1	4	1	95.9875	1	5	216.3462	9.7644	0.1357	9.7644	0.0231	-0.0003	0.01
1	4	1	95.9875	1	6	99.734	9.7647	0.0619	9.7647	0.0106	-0.0003	0.01
1	4	1	95.9875	1	7	45.9559	9.7648	0.0293	9.7648	0.005	-0.0003	0.01
1	4	1	95.9875	1	8	21.3068	9.7647	0.013	9.7647	0.0022	-0.0003	0.01
1	4	1	95.9875	1	9	9.9102	9.7647	0.0065	9.7647	0.0011	-0.0003	0.01

Figure 19-21 ACIM Data in CSV Format

3) You can also click the "Export Test" icon in the toolbar to open the "Export" Interface and select the settings to export the data to Excel.

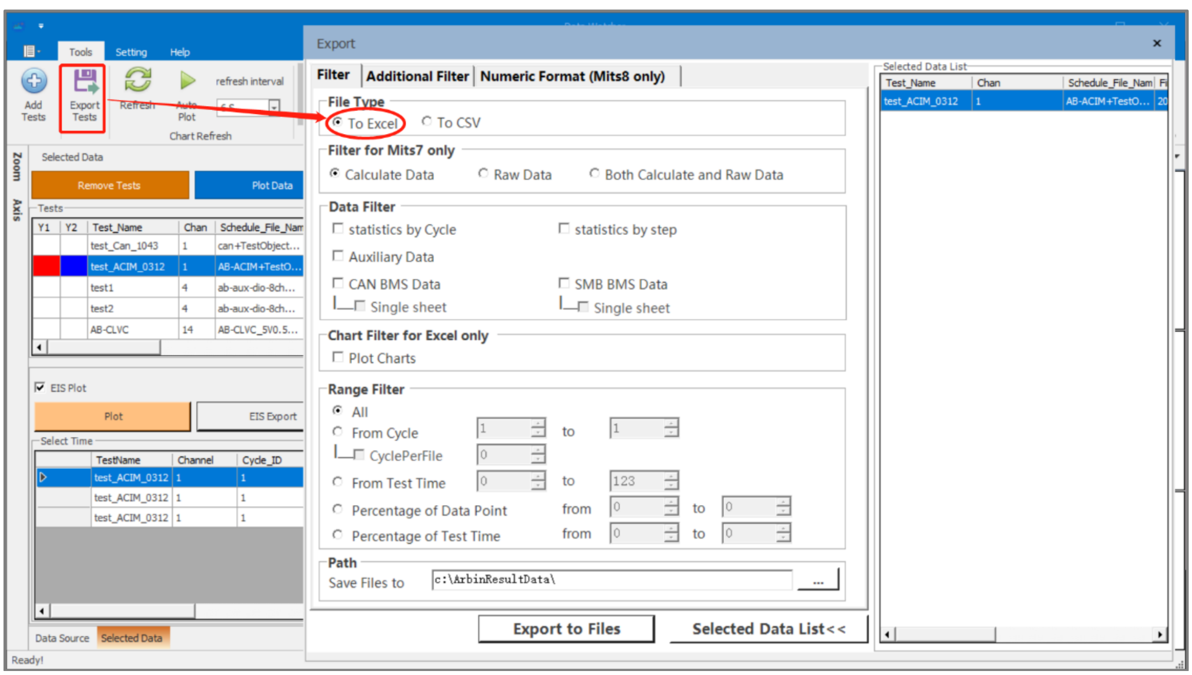
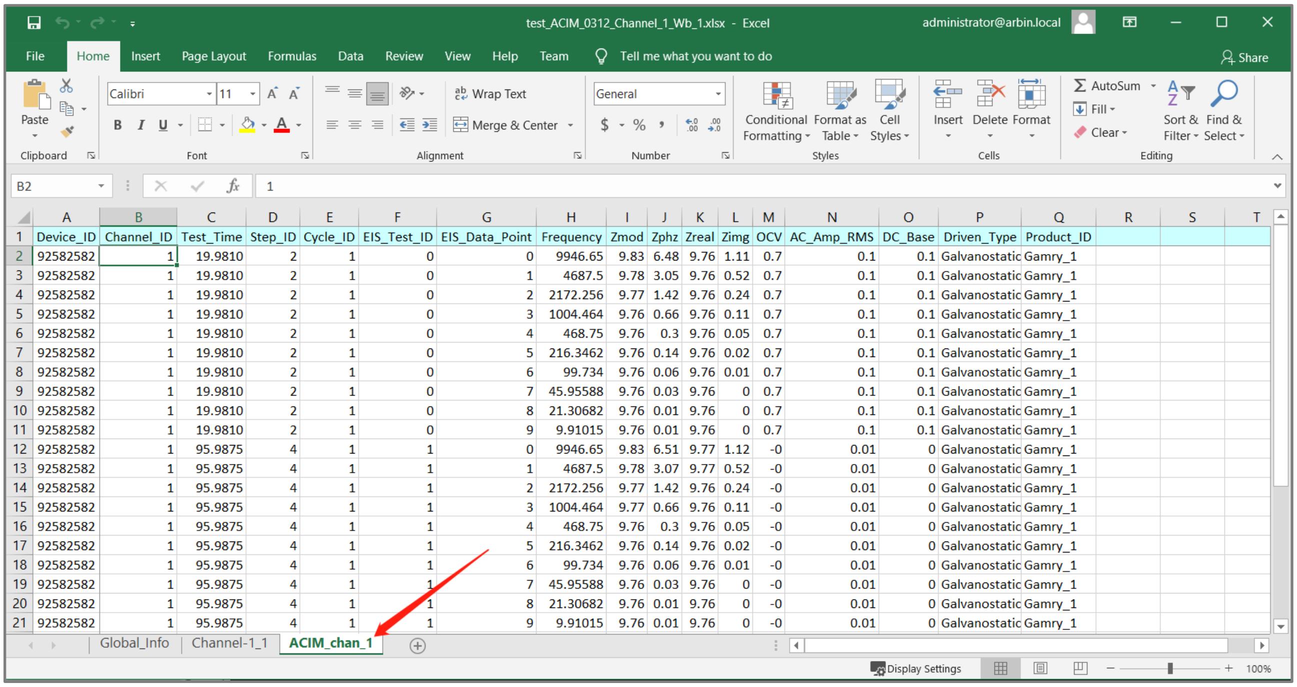


Figure 19-22 ACIM Data Export to Excel

4) The ACIM data will appear in the ACIM tab of the Excel file (Figure 19-23).



Device_ID	Channel_ID	Test_Time	Step_ID	Cycle_ID	EIS_Test_ID	EIS_Data_Point	Frequency	Zmod	Zphz	Zreal	Zimg	OCV	AC_Amp_RMS	DC_Base	Driven_Type	Product_ID
92582582	1	19.9810	2	1	0	0	9946.65	9.83	6.48	9.76	1.11	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	1	4687.5	9.78	3.05	9.76	0.52	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	2	2172.256	9.77	1.42	9.76	0.24	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	3	1004.464	9.76	0.66	9.76	0.11	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	4	468.75	9.76	0.3	9.76	0.05	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	5	216.3462	9.76	0.14	9.76	0.02	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	6	99.734	9.76	0.06	9.76	0.01	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	7	45.95588	9.76	0.03	9.76	0	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	8	21.30682	9.76	0.01	9.76	0	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	19.9810	2	1	0	9	9.91015	9.76	0.01	9.76	0	0.7	0.1	0.1	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	0	9946.65	9.83	6.51	9.77	1.12	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	1	4687.5	9.78	3.07	9.77	0.52	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	2	2172.256	9.77	1.42	9.76	0.24	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	3	1004.464	9.77	0.66	9.76	0.11	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	4	468.75	9.76	0.3	9.76	0.05	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	5	216.3462	9.76	0.14	9.76	0.02	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	6	99.734	9.76	0.06	9.76	0.01	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	7	45.95588	9.76	0.03	9.76	0	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	8	21.30682	9.76	0.01	9.76	0	-0	0.01	0	Galvanostatic	Gamry_1
92582582	1	95.9875	4	1	1	9	9.91015	9.76	0.01	9.76	0	-0	0.01	0	Galvanostatic	Gamry_1

Figure 19-23 ACIM Data in Excel on the ACIM (EIS) Tab

19.3.2 Troubleshoot ACIM/EIS

Overload

During the EIS test, the user might observe overload (red or orange data points), indicating that the instrument is in a bad state. When an overload occurs, the following indicators will alert you of this issue:

1) The data point at the overload point will turn red of orange, as mentioned above.
2) One of the five indicator lights will light up.
3) The bottom of the testing data will display a red or orange box with a message to indicate which overload condition has occurred.

The following provides a description of each of the types of overload:

- **I OVLD** indicates a current overload. The sample area may be too large, or the battery/supercapacitor/fuel cell may generate too much current for the potentiostat hardware.
- **V OVLD** indicates a voltage overload. The voltage of the battery/supercapacitor/fuel cell is too high to measure, or the electrometer is disconnected and drifts onto the rail. Double-check the white wires and blue wires and make sure they connect correctly.
- **CA OVLD** indicates the control amplifier is overloaded. The voltage regulator cannot provide enough current between the working lead and the counter-lead to reach the required electric potential on the working electrode. The blue or white wire may become disconnected, or the uncompensated resistance of the battery is too high that the instrument reaches its compliance voltage.

- **I ADC** indicates that the current channel A/D converter has been installed. Wrong instrument settings were used during the EIS scan. During the AC measurement, the battery status may change too much to obtain a valid reading.
- **V ADC** indicates the voltage channel A/D converter has been installed on the rail. Wrong instrument settings were used during the EIS scan. During the AC measurement, the battery status may change too much to obtain a valid reading.

Poor Connection/Broken Circuit

Whenever the connection is poor or broken, the following content will appear in the Gamry software:

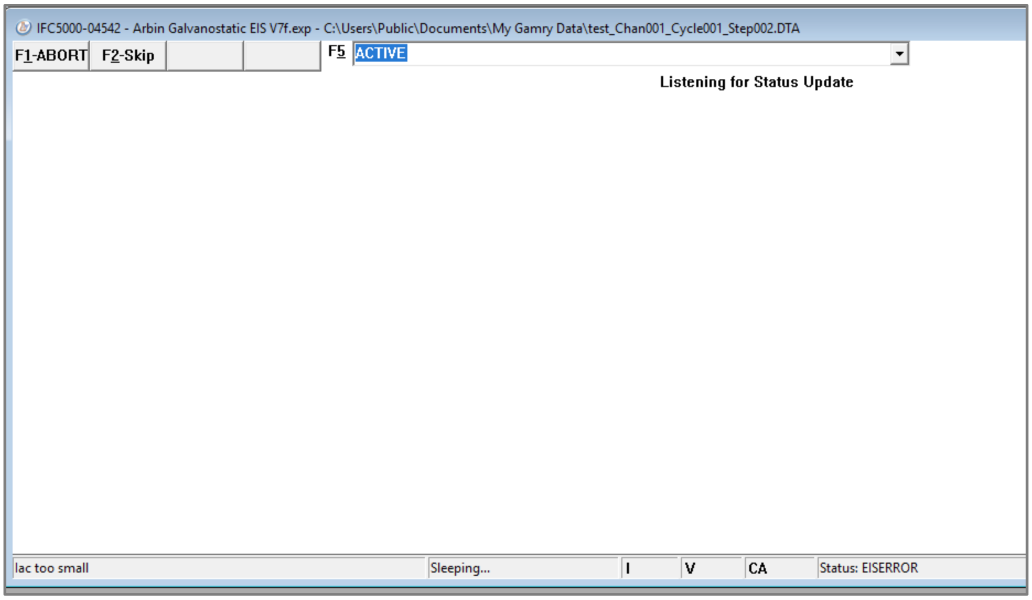


Figure 19-24 Poor Connection/Broken Circuit

To resolve this issue, check the connection of the device under test (DUT) and restart the test.

Framework Issues

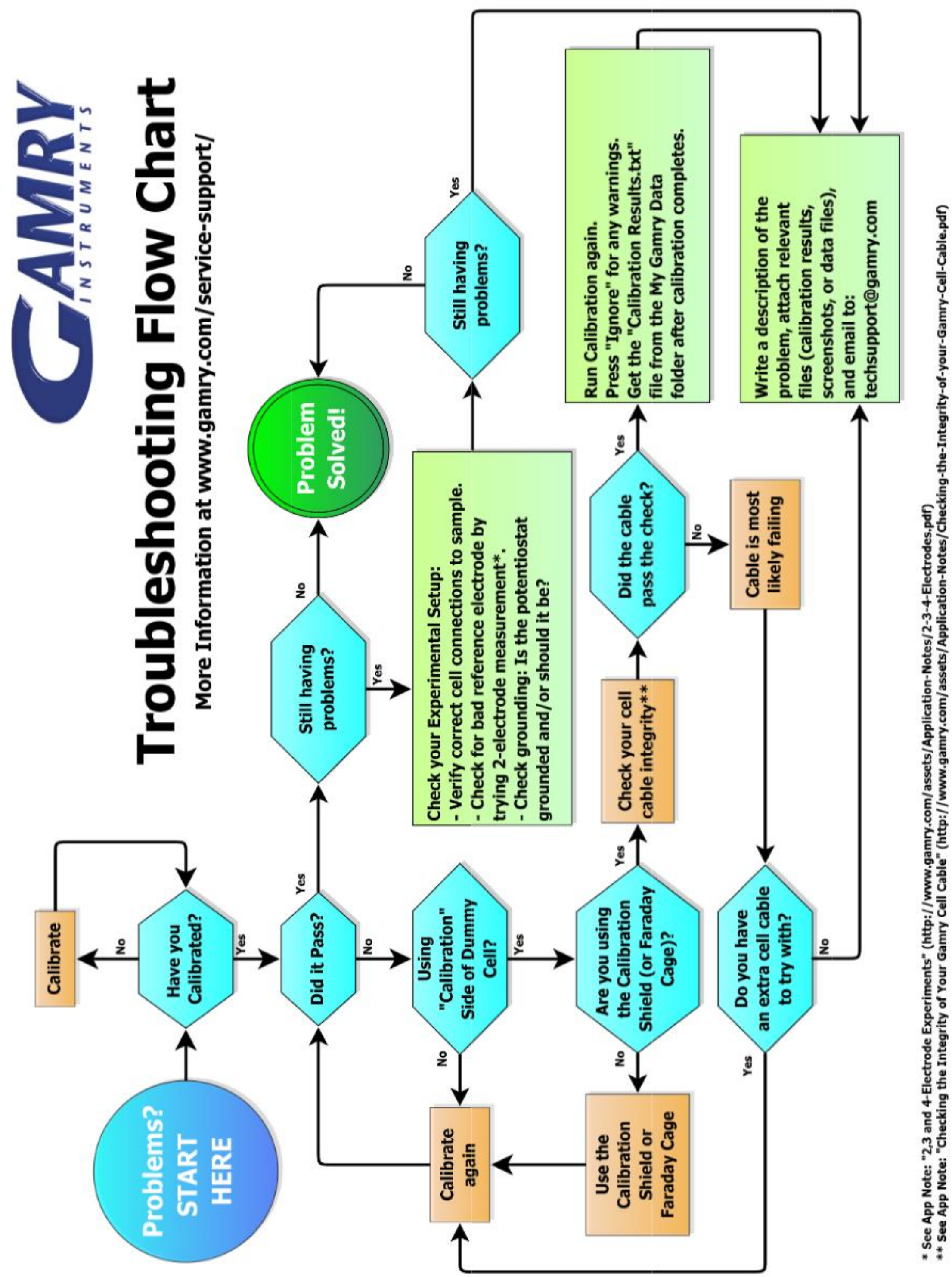
- **Not authorized by the potentiostat** – The potentiostat lacks one or more of the authorization codes that are required to unlock the test.
- **VRUPDN.New: Invalid signal** – When doing the CV tests, the order of the scan restrictions is wrong. The initial value cannot be equal to scan limit 1, and scan limit 1 cannot be equal to scan limit 2, but scan limit 2 can be equal to the final limit.
- **Firmware mismatch** – The firmware version of the potentiostat is not compatible with the installed Framework version. Please update to the latest version of the software and install the firmware or contact Arbin Customer Support.
- **Mux: Not open** – The software cannot establish communication with the ECM8 Multiplexer. This is usually caused by using an incorrect COM port. Contact Gamry for help.
- **Mux: Error on COM65535** – The software cannot establish communication with the ECM8 multiplexer. This is caused by incorrect COM port settings. Contact Gamry for help.

- **Vac is too small** – The measured AC signal is too small. The most likely cause is an open connection between the samples or a faulty battery cable.
- **The Pstat device list is empty** – The Framework software has not detected any instruments, so the test setting Interface cannot be loaded.
- **Reply_timeout** – The communication between the host and the USB regulator is lost. An arid environment may cause damage to the USB cable or electrostatic shock. Turn off the instrument's power and disconnect the USB cable for 10 seconds to re-establish the communication.

Echem Analysis Issues

- **No curve found in the data file** – If the experiment ends unexpectedly or aborted prematurely, the data file may have all setting information except for the part where the data points are stored.
- **Unable to open the specified analysis script** – Before version 5.63, only specific analysis scripts could be installed. If you try to view a data file without the analysis script installed, you will receive this error. In addition, for all the versions, when you view a data file that requires a custom analysis script, and the script assigned incorrectly in the custom analysis script database file, you will receive this error.
- **Invalid Gamry data file** – The data file is not in Gamry format or is damaged.

Gamry Troubleshooting Flowchart



19.4 Multi-Zone Temperature Control Chamber

Figure 19-25 Front View of the Multi-Zone Temperature Control Chamber (MZTC)

19.4.1 What is Multi-Zone Temperature Control?

The multi-zone temperature control chamber (MZTC) is designed to keep the battery temperature constant during testing. MZTC has 8 independently controlled temperature control chambers and can test up to 32 individual batteries depends on the battery tray. The MZTC temperature range is 10°C to 60°C.

MZTC has two operating modes:

1) **Local Mode** – Allows you to control the temperature of each chamber using the built-in touch screen.
2) **Remote Mode** – Allows you to the use the Mits X software to control the temperature of each chamber. You assign temperature settings to each chamber in the test Schedule.

To switch to the operation mode:

1) Select the Setting tab on the MZTC touch screen.
2) Select the desired operation mode, either local mode or remote mode. If the power is turned on, no matter which operating mode is selected, MZTC will display each chamber's current temperature and status.

NOTE: When Mits X controls MZTC, it will automatically switch to the remote mode. It cannot be manually switched back to local mode until the test completes.

Figure 19-26 The Temperature Monitor of MZTC

19.4.2 Use the Multi-Zone Temperature Control chamber

General Operation of the Multi-Zone Temperature Control chamber

This section presents general guidelines for the correct operation of MZTC. **Please read the precautions!**

Operating the Battery Tray

The battery tray has two knobs to open or close each chamber, as shown in the figure below. Before starting tests, make sure that each chamber is closed. Failure to turn the knob to the closed position will make the temperature chamber uninsulated.

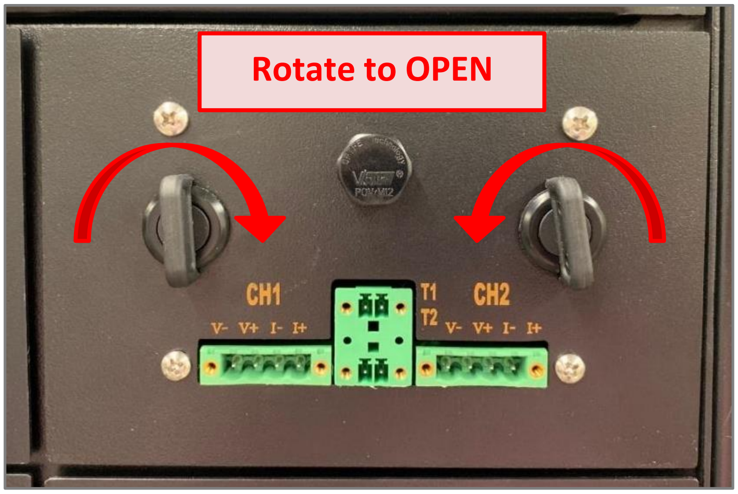


Figure 19-27 Rotate the Handle Inward to Remove the Battery Board from the Battery Compartment


Figure 19-28 Retrieve the battery board of No. 1 test box

Please note that the inside of the chamber is visible.

Insert the battery into the battery tray

There are several types of battery trays for different types of batteries. Please make sure that the battery you are not retrieving or discharging has the current larger than the rated current.

When loading the battery into the battery tray, make sure that the battery tray is placed on a flat, **non-conductive surface**. Also, connect the battery to the battery tray and make sure to follow the correct voltage polarity. Finally, be careful when removing the battery from the battery tray, as the battery can be scorching.

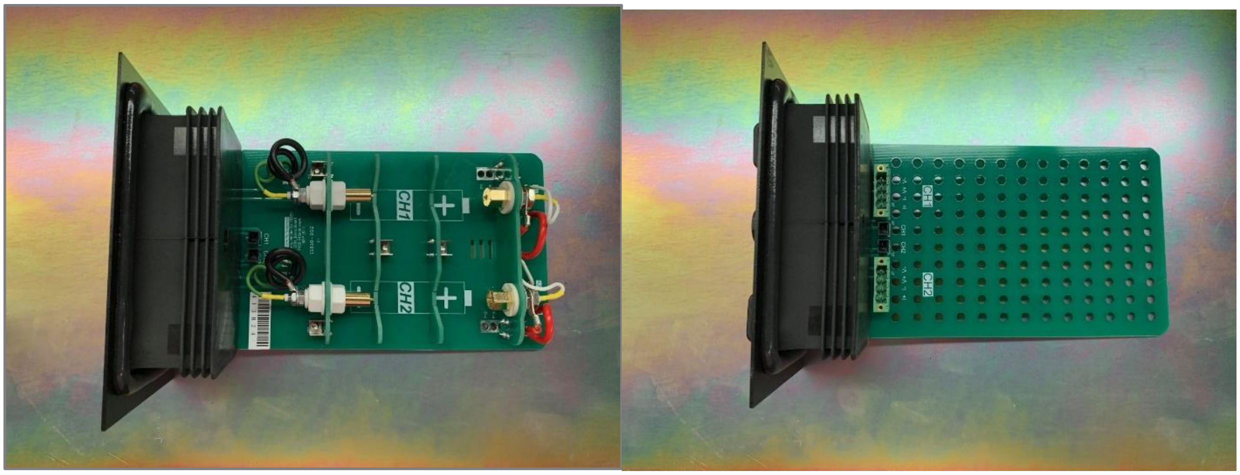


Figure 19-29 Cylindrical Battery Tray (Left) and Universal Battery Tray (Right)

Connect the IV Cable to the Battery Tray

After the battery tray is installed correctly and placed firmly in the MZTC, the IV cable can be connected from the Arbin Tester to the MZTC. Ensure the IV cable is secured to the battery tray by tightening the screws on the Phoenix connector. Make sure to use cables with appropriate current ratings and follow the corresponding Arbin wiring conventions (V-, V+, I-, I+).

Airflow Placement and Clearance

The weight of the MZTC is 110 lbs. (50 kg), so two people are required to lift and move the MZTC. The airflow direction of MZTC is from right to left. MZTC requires a 1.6 ft (0.5m) gap in each direction to ensure the correct air circulation. Make sure that no other machine/equipment discharges hot air into the cold air inlet of the chamber.

Maintenance and Cleaning

The design of the chamber requires almost no maintenance, but if a component breaks down/is damaged, we recommend Arbin-approved personnel to perform the maintenance. The cabinet should be operated in a clean laboratory without large dust particles or corrosive fumes.

It is recommended to clean the inside and outside of the chamber every year. Before cleaning the chamber, disconnect the power cable from the chamber and unload all battery trays. The chamber can be cleaned gently with compressed air to remove dust and cleaned with a microfiber cloth dipped in isopropyl alcohol or ethanol. Before reconnecting the power cord of the MZTC, please ensure that both inside and outside of the MZTC are dry.

NOTE: There may be toxic substances from batteries/batteries inside the chamber. Make sure to remove it safely and correctly.

Operate the Multi-Zone Temperature Control chamber in Local Mode

The following sections explain how to use the built-in touchscreen to operate MZTC in local mode.

Select Local Mode

The temperature monitor displays the operating mode in both the Overview and Setting Interfaces.

1) On the touchscreen, select the Setting tab to open the "Setting" Interface. This Interface displays the operating mode and version information of the temperature monitor touchscreen program.

Figure 19-30 Select the Setting Tab to Switch Between Local and Remote Modes

2) Select the "Local Mode" button to switch to local mode. The Operating Mode setting will show "Local" in green to show that Local Mode has been selected.

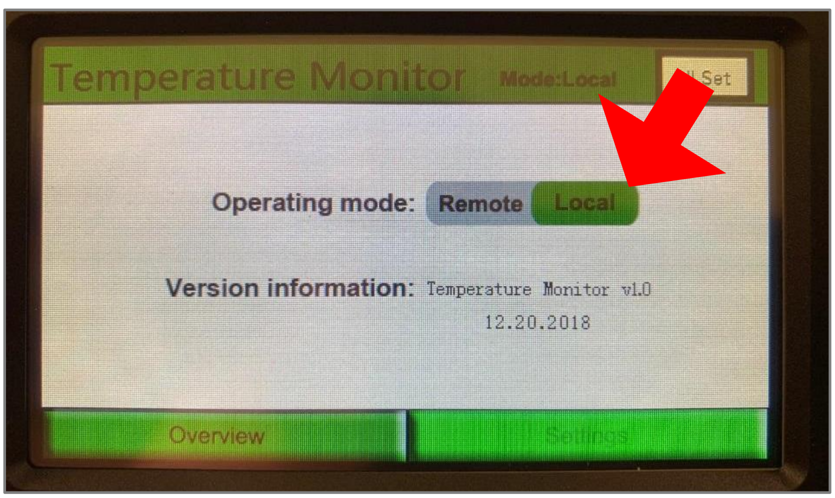


Figure 19-31 Select Local Mode in the Setting Interface

NOTE: If MZTC is in Remote Mode and running the Schedule using the Mits X software, you will not be allowed to change the operation mode to Local Mode until the Schedule completes.

Control the Temperature Separately

1) Make sure that MZTC is operating in Local Mode.
2) In the “Overview” Interface of the touchscreen, select the desired temperature control chamber to be controlled, CH1 in Figure 19-32 below.

Figure 19-32 Overview Interface

3) A “Set for Chamber” Interface will appear showing the current temperature, temperature setpoint, and safety limit of the selected chamber. Click in the target temperature box to set the target temperature.

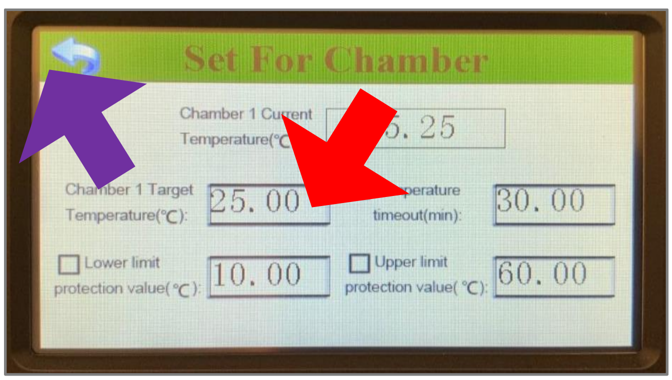


Figure 19-33 Setting the Target Temperature of Each Chamber

4) In the calculator that appears, manually enter the target temperature within the range of 10°C to 60°C.

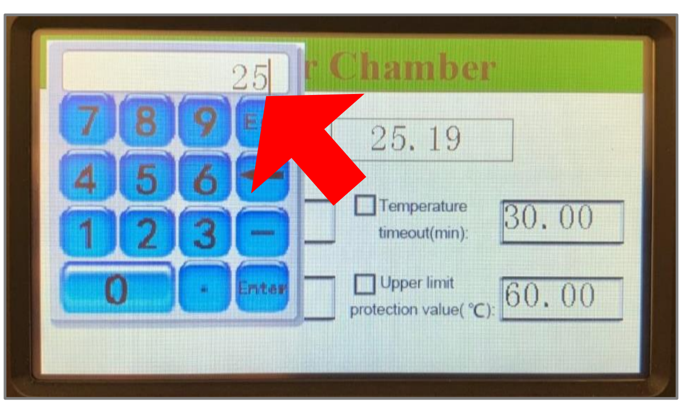


Figure 19-34 Manually Enter the Target Temperature Setpoint for a Single Chamber

5) Select the “Enter” button the calculator Interface to set the entered value as the target temperature for the chamber.
6) Select the blue return arrow in the upper left corner (indicated by the purple arrow in Figure 19-33) to return to the “Overview” Interface.

Open and Close Chambers

1) Select the “Status” button for the chamber that you want to manage.
   a) A green circle under “Status” in the Overview Interface indicates that the chamber is open; a red circle indicates that the chamber is closed.

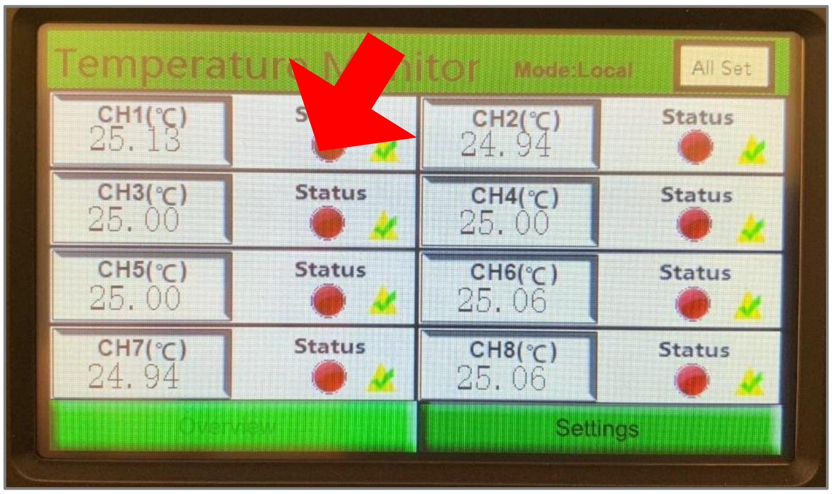


Figure 19-35 Select the Status Tab of Each Chamber to be Opened

2) In the “Status” Interface that appears, you will be asked “Do you want to turn this temperature control chamber on/off?”
   a) Select the “Yes”” button to open or close the selected chamber.
   b) Select the “No” button to close the “Status” Interface without changing whether the chamber is closed or open.

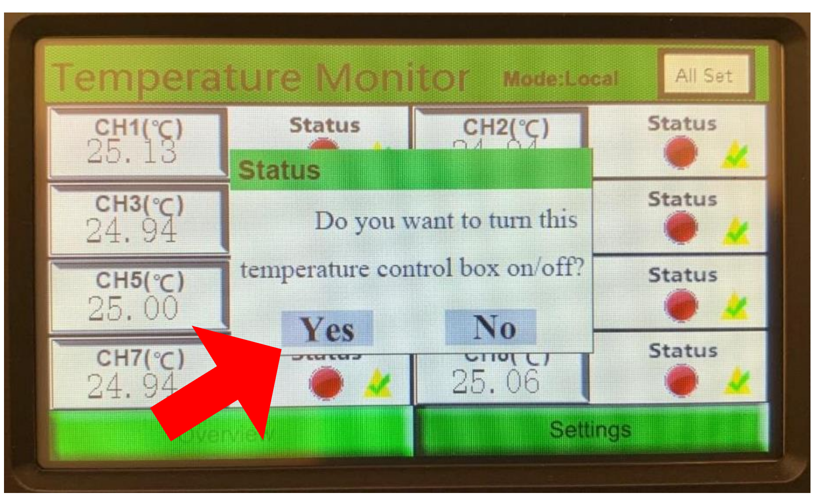


Figure 19-36 Select the Yes Button to Open or Close Each Chamber; Select the No Button to Close the Status Tab

Collective Control of Temperature

1) Make sure that MZTC is operating in Local Mode.
2) In the “Overview” Interface of the touchscreen, select the “All Set” button in the upper right.

Figure 19-37 Select the All Set Tab to Control All Chambers Together

3) The “Set For All Chambers” Interface will open, which shows the temperature setpoints and safety limits assigned to all temperature control chambers. To make changes to these fields, please select their specific boxes and then use calculator Interface that appears to enter the appropriate values.
4) There are two buttons, "Turn On" and "Turn Off" which simultaneously control all temperature control chambers.

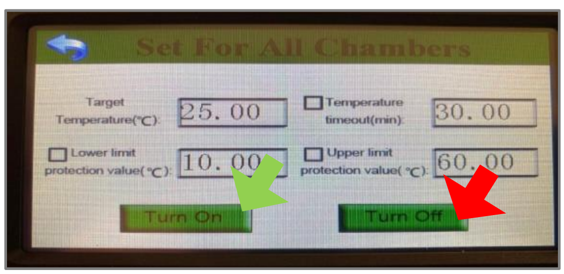


Figure 19-38 Manually Enter the Target Temperature for All Chambers; User Can Turn Off or Turn On All Chambers.

5) Select the blue return arrow in the upper left corner to return to the Overview Interface.

Figure 19-39 The Overview Interface Shows All Chambers are Open (Left) or Closed (Right)

Operate the Multi-Zone Temperature Control chamber in Remote Mode

The following sections explain how to operate and configure the MZTC for remote mode, which allows the chamber to be controlled via the Mits X software. These sections assume that the user has a good understanding of creating Schedules, modifying Mapping, and running tests on Mits X software. Please refer to **Arbin Instruments Mits X User Manual**, and contact Arbin Customer Support if you have other questions about the software or about using remote mode.

Select Remote Mode

The temperature monitor displays the operating mode in both the Overview and Setting Interfaces.

1) On the touchscreen, select the Setting tab to open the “Setting” Interface. This Interface displays the operating mode and version information of the temperature monitor touchscreen program.

Figure 19-40 Select the Setting Tab to Switch Between Local and Remote Modes

2) Select the “Remote Mode” button to switch to local mode. The Operating Mode setting will show “Remote” in green to show that Remote Mode has been selected.

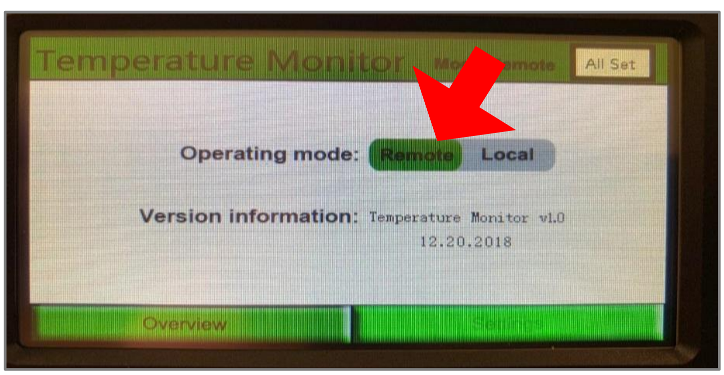


Figure 19-41 Select Remote Mode in the Setting Interface

NOTE: When Mits X controls MTC, it will automatically switch to Remote Mode. It cannot be manually switched back to Local Mode until the test is complete.

Develop and Control MZTC

1) Before creating the Schedule that will control MZTC, it is important to verify whether the Advanced Feature is available on the system.
2) Create a new Schedule or modify an existing Schedule on the Mits X software.
3) Go to the Test Setting tab and determine the temperature control value here.
4) Add a Test Setting element. You can modify its label, type, and control value.

Figure 19-42 below shows several test settings. For example, there is a test setting labeled "10 DEG," its type is "temperature", and its control value is 10, which in this article refers to 10°C. In addition, its secondary virtual index nickname is 1.

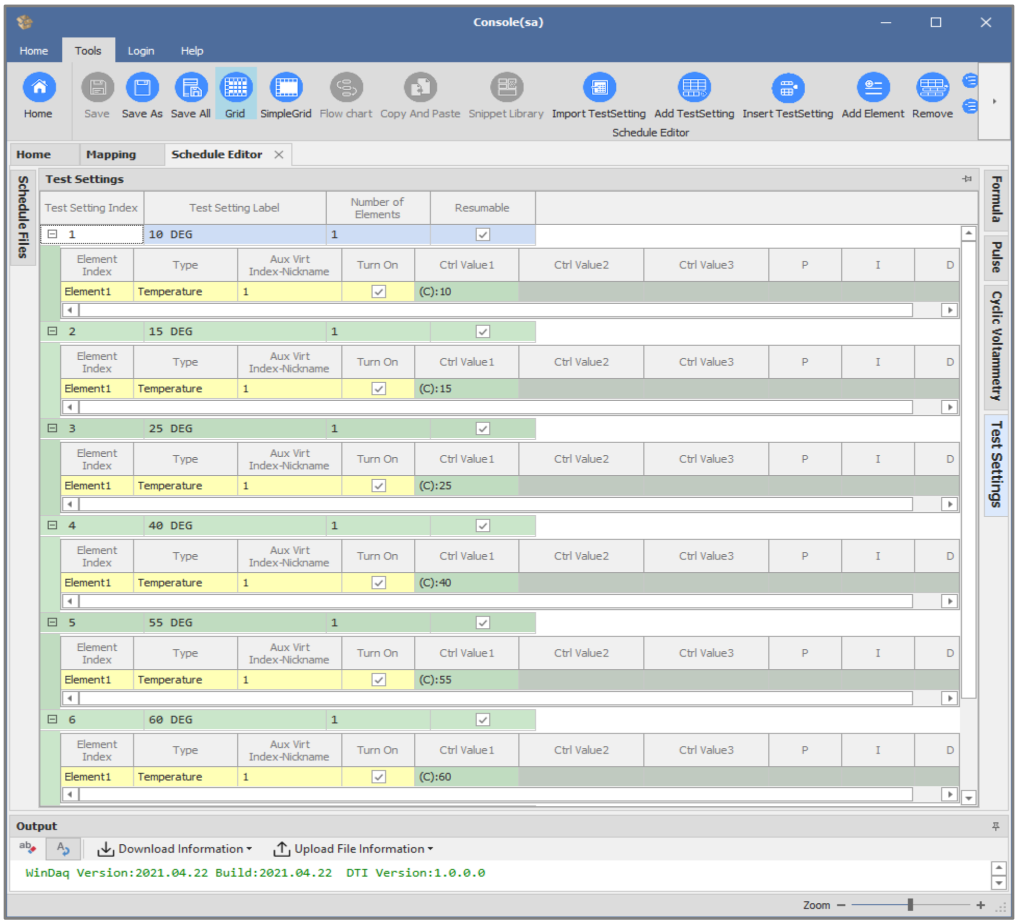


Figure 19-42 The Temperature Setpoints are Stored in the Test Setting Tab

5) After creating all the Test Setting elements required for the schedule, a column will be added that is labeled Test Setting. You can choose the required test setting for that step by selecting the corresponding test setting from the drop-down menu.

Figure 19-43 shows the first 7 steps of the plan to generate the data in Figure 10-49. Mits X provides a lot of flexibility in how to control and convert between various steps.

The completion of the step can be determined by the steps of the channel, including step time, test time, voltage, current, capacity, temperature value, or other conditions.

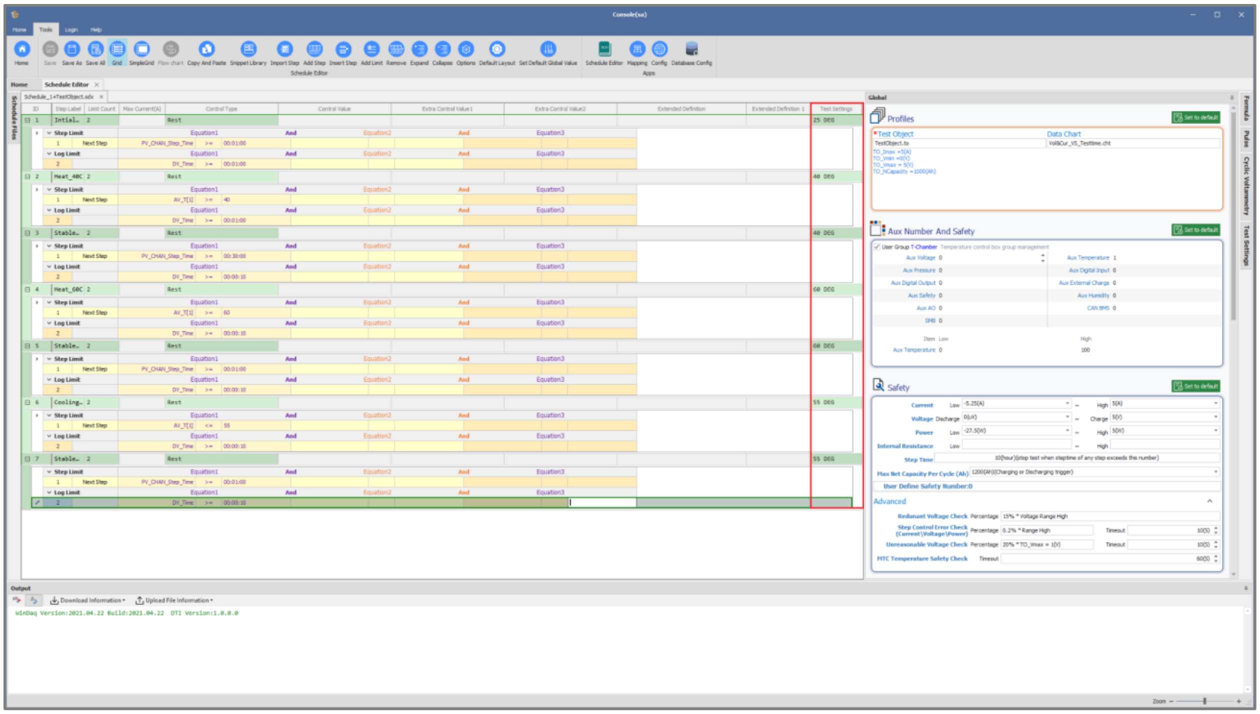


Figure 19-43 Example Schedule Using Test Setting to Control MZTC Temperature

The Steps in Figure 19-43 have two different completion conditions:

1) The temperature in the chamber reaches its temperature control value (steps 2, 4, and 6).
2) The Step Time reaches a certain period. (Steps 1, 3, 5, and 7).

Note that the control value of the exit condition used for (steps 2, 4, and 6) uses the term "AV_T [1]." The term refers to the secondary virtual index nickname 1. This does not mean that it is the No. 1 temperature control chamber. It means when you assign this test to a specific IV channel, the temperature information will come from the temperature sensor mapped to that IV channel in the Batch file. You can also use other temperature sensor data mapped to the IV channel. For example, if you attach a PT100 sensor to the battery in a specific temperature control chamber, you can use this data to control the completion of the step.

In this example, you may want to start charging or discharging the battery after the specific surface temperature reaches a specific value outside the temperature box setting. During the temperature transition, the surface temperature of the battery may take longer to reach the value of the temperature setpoint of the chamber.

Determine the Safety Limit

The final step in creating a Schedule is to determine the "safety limit" in the Global tab. Safety limits can be set for current (A), voltage (V), and temperature (°C). If the advanced function of the MZTC temperature check is provided in the system, the time (in minutes) that allows a single temperature box to reach its temperature Control Value can be determined. When MZTC takes longer than the allowed time, the test will stop.

NOTE: This timer is reset every time other test settings are used.

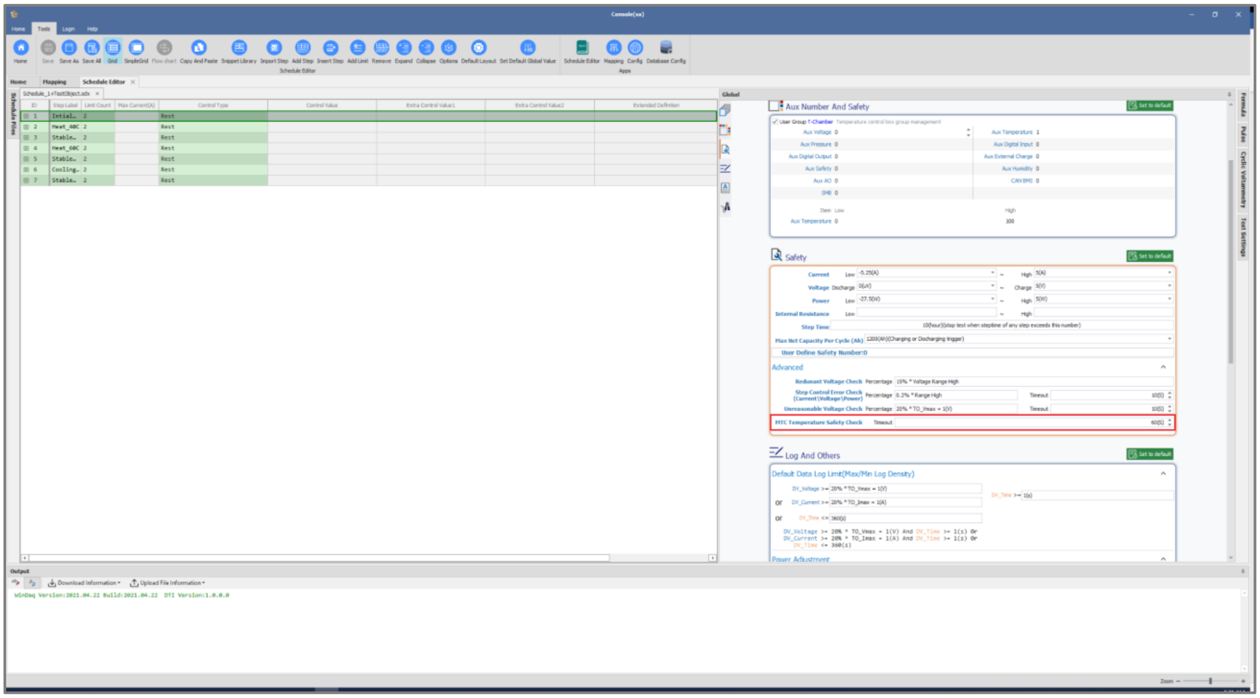


Figure 19-44 The Safety Limit Can Be Determined on the Global Tab of Any Schedule

Modify the Mapping on the Batch Files

There are three main ways to add MZTC to batch files:

1) Map an IV channel to a temperature control chamber (Figure 19-45).
2) Map the two IV channels to a temperature control chamber (Figure 19-46).
3) Map other PT100 sensors to the temperature control chamber and IV channel.

We recommend contacting Arbin Support for supervision and guidance when changing batch files to maintain safety for your team members and systems.

Please note that in Figure 19-46, the auxiliary channel virtual index highlighted with a red box is related to the term "AV_T [1]" described in the previous section, which discusses how to create a Schedule to control MZTC.

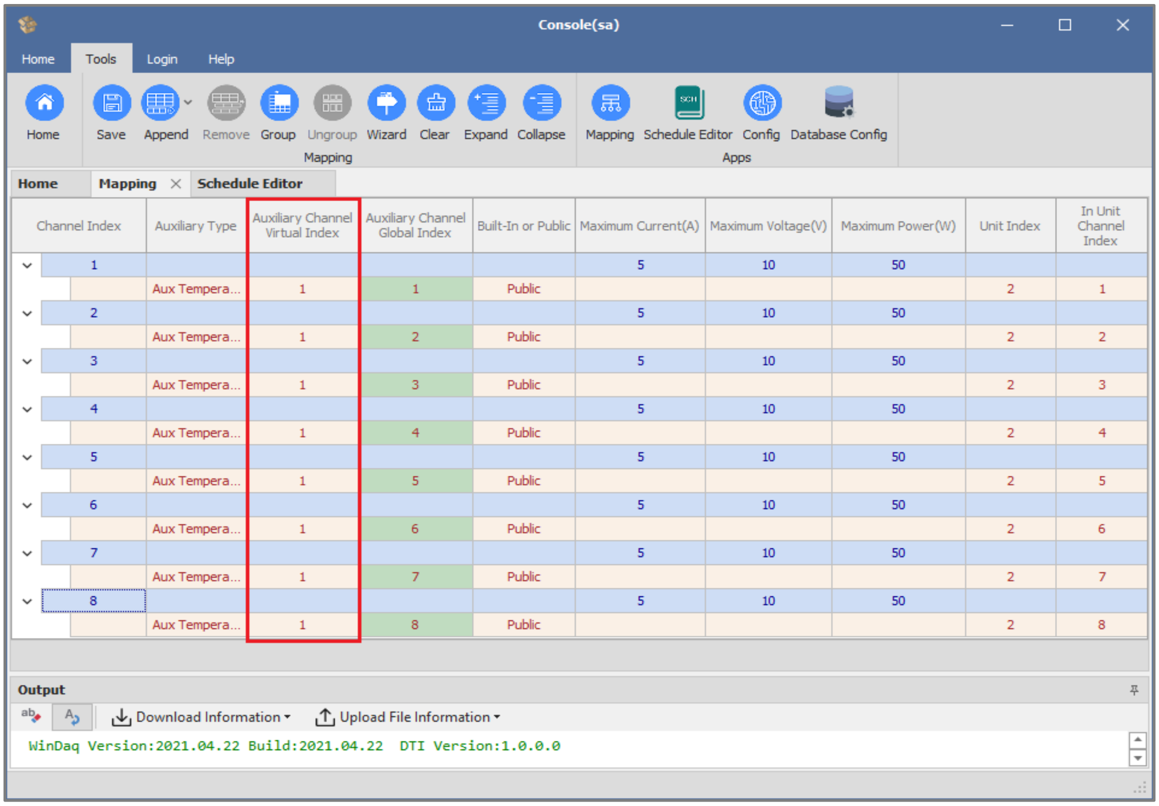


Figure 19-45 Mapping of an IV Channel and a Temperature Chamber

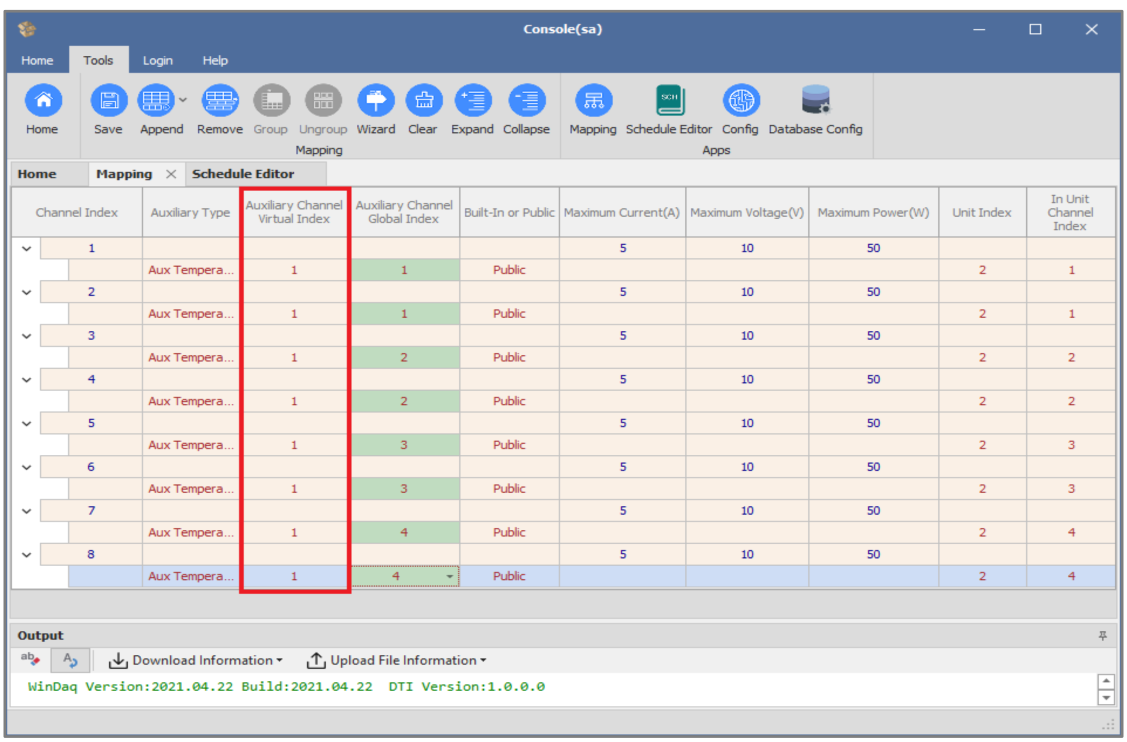


Figure 19-46 Two IV Channel Diagrams of a Temperature Control chamber

__Run a Schedule from the Monitor Interface__

1) In the Mits X software, open the "Monitor" Interface.
2) Select the required IV channel that is correctly connected to the temperature control chamber.
3) Assign the channel to a Schedule, which should contain temperature Control Values and test control standards. If the MZTC is configured and mapped correctly, the current temperature of the channel will be displayed in the corresponding column.
4) When you are ready to start the test, select the desired IV channel and start the test by clicking the running human icon.

Figure 19-47 shows that channel 1 is selected in the "Monitor" Interface, and a new test is started with the name "Temperature_Control_Test". Please note that after starting the test in remote mode, the status of the temperature control chamber will change from red (OFF) to green (ON). Only the chambers that run the Schedule will be activated.

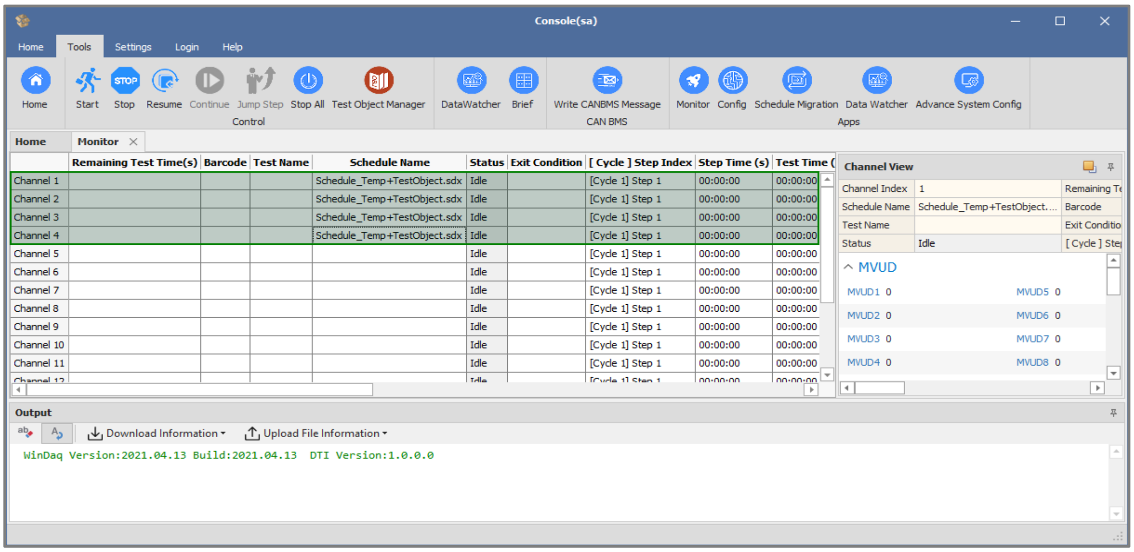


Figure 19-47 Start the Test on the Monitor Interface

Figure 19-48 Overview Interface, Showing All Chambers Under Remote Control

In addition to the “Monitor” Interface, you can also use the DataWatcher program to monitor temperature, voltage, and current data. After running the Schedule with different temperature Control Values, the temperature reading of room #1 is lower.

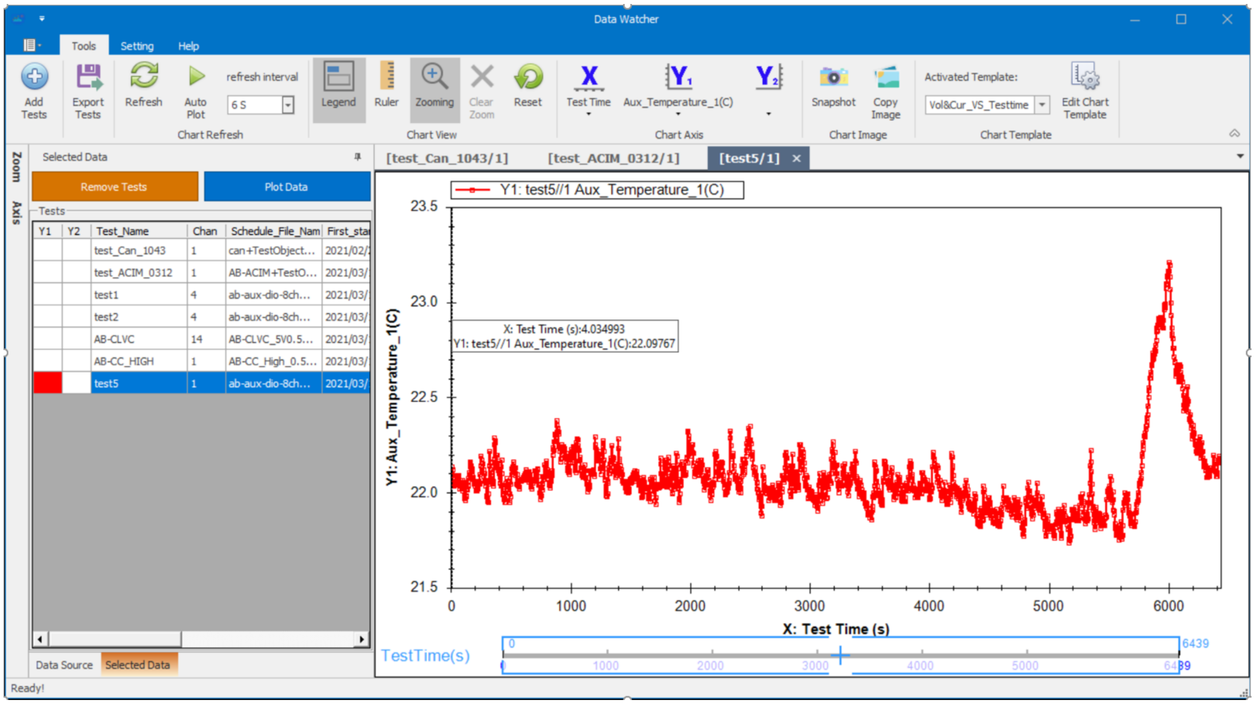


Figure 19-49 The Temperature Data From Room 1 Displayed in DataWatcher

19.4.3 Safety for the Multi-Zone Temperature Control chamber

We designed MZTC with safety in mind closely. There are some security features on both hardware and software so that users can better mitigate risks. **Please read the precautions!**

Hardware Protection

In terms of hardware, in addition to the sturdy steel structure, each chamber of the MZTC also has a pressure relief valve located on the front of the chamber, which can discharge gas if the battery overheats.

Figure 19-50 The Pressure Relief Valve is Located on the Door of Each Chamber

Software Protection in Local Mode

In terms of software, users can set multiple safety limits in Local Mode to prevent each chamber from being higher or lower than a specific temperature "up/down protection value" (in degrees Celsius). There is a special safety limit called Temperature timeout, the maximum time (in minutes) allowed for each air chamber to reach its temperature Control Value. These safety limits can be selected for each chamber or all chambers within the MZTC. The user can select the safety limit to be activated: temperature timeout, lower limit protection value and/or upper limit protection value, as shown in Figure 19-51.

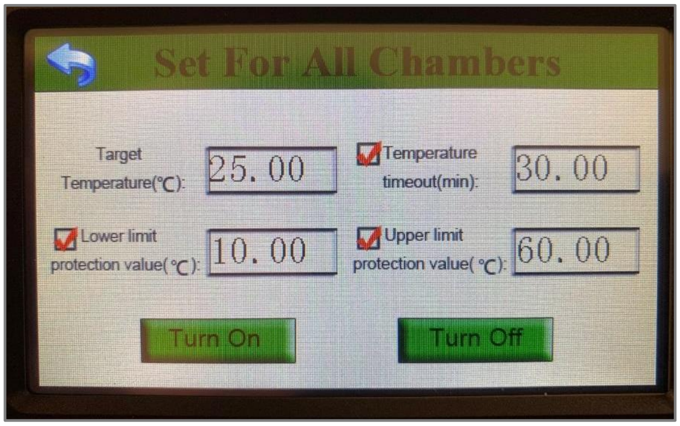


Figure 19-51 Safety Limits

Each chamber is counted by a status indicator, which displays Safe or Unsafe status.

1) A Safe status indicates that the temperature control chamber is operating within the safety limits. This is shown by a green checkmark in the Status box for the chamber.
2) An Unsafe status indicates that the temperature control chamber is operating outside of the safety limits. This is shown by an exclamation point within a yellow triangle in the Status box for the chamber (Figure 19-52).
   a) When this happens, each temperature control chamber will be closed
   b) Touching the warning sign will display a warning message, as shown in Figures 19-53 to Figure 19-55.
   c) After the warning message is manually cleared, the temperature control chamber can be controlled again.

NOTE: If MZTC uses Mits X to run tests in Remote Mode, it cannot check for Unsafe messages.

Figure 19-52 Status Indicator Displaying a Warning Signal

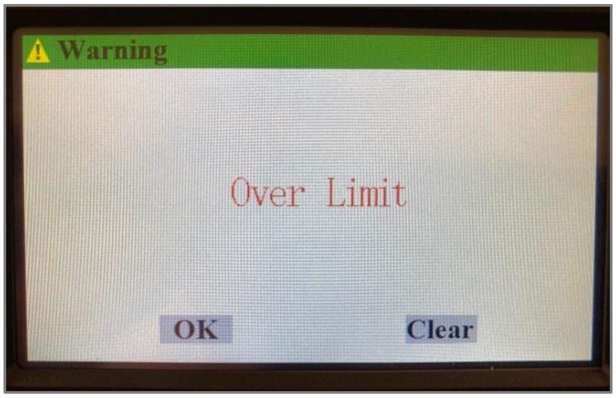


Figure 19-53 Temperature is Higher Than Lower Limit or Lower Than Lower Limit

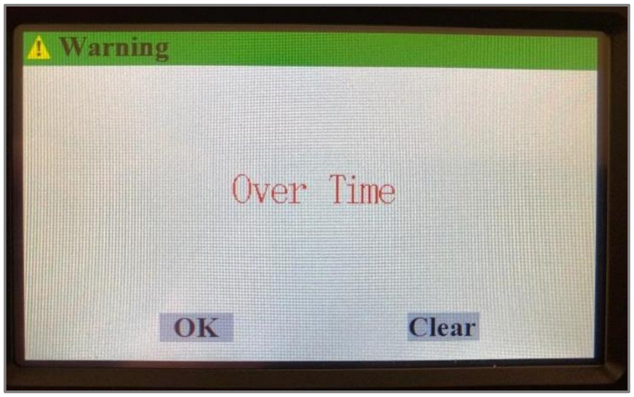


Figure 19-54 Chamber Exceeds Timeout Safety Limit Before Reaching Temperature Setpoint

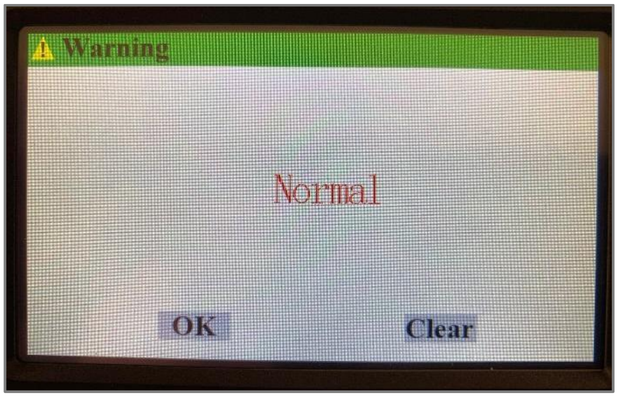


Figure 19-55 Message Displayed When Chamber is in Normal/Healthy State

Software Protection in Remote Mode

When creating a Schedule in the Global tab, the Mits X software allows you to add security restrictions. Safety limits are set for current (A), voltage (V), and temperature (°C). If the advanced function of the MTC temperature check is in the system, the time (in minutes) that allows a single temperature box to reach its temperature Control Value can be determined. When MZTC takes longer than allowed, you can decide whether to stop the test in the Monitor Interface or issue a warning.

NOTE: This timer is reset every time other test settings are used.

This advanced feature is highlighted in the red box in Figure 19-56 below.

Another safety function is to use the Auxiliary Channel Safety Limit section to set the chamber's upper limit/lower limit temperature in the Schedule. Select this function by checking the box to the left of "Temperature [C] "and enter the maximum/minimum temperature.

You can also use the User Define Safety section to set the upper/lower limit of the chamber temperature in the Schedule.

1) Select the virtual index "AV_T [1]" of the auxiliary channel of the reference chamber temperature sensor.
2) Select the maximum and minimum values in degrees Celsius. Figure 19-56 below shows a schedule that will allow a single chamber to operate in a temperature range of 20°C to 40°C.

When switching between the two modes, all security restrictions will be cleared.

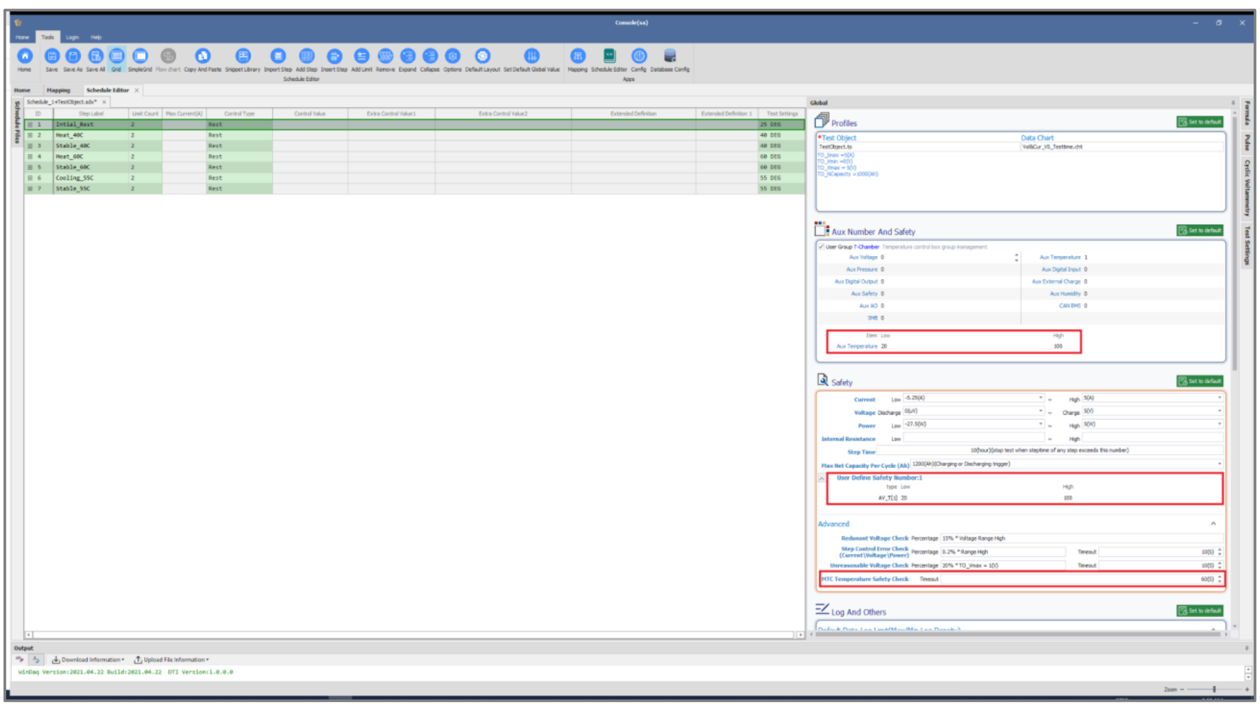


Figure 19-56 Security Features of MZTC on the Global Tab of Schedule

19.4.4 Product Specifications

General	
Independently controlled chamber	8-chamber
Maximum number of batteries	8~32
Maximum current of each battery tray	Please refer to Table 19-1.
Size	
External	
Height	5588 mm (22 inches)
Width	3175 mm (12.5 inches)
Depth	3064 mm (16 inches)
Internal (Each Chamber)	
Height	762 mm (3 inches)
Width	1143 mm (4.5 inches)
Depth	1778 mm (7 inches)
Weight	50 kg (110 lbs.)
Power Supply	
Voltage Range (Single Phase)	90~264 VAC
Frequency Range	47~63 Hz
Maximum Power Consumption	950 W
Maximum Current	10 A
Temperature Performance	
Maximum Temperature	60°C
Minimum Temperature	10°C
Temperature Control Accuracy	±0.5°C
Temperature Control Resolution	0.0625°C
Temperature Stabilization Time (No Load)	30 min.
Surroundings	
Working Temperature	18°C～28°C
Storage Temperature	5°C～45°C
Relative Humidity	<90%
Altitude	2000 m (6500 ft.)

*Please refer to Table 19-1: Battery Trays for Multi-Zone Temperature Chambers.

Table 19-1 Battery Trays for Multi-Zone Temperature Chambers

Battery tray	Maximum current	Number of units	PT100 support	Arbin Model
Coin Cell	5A	2	Yes	#413820
	5A	4	No	#413822
Cylindrical Cell	10A	2	Yes	#413824
	30A	1	Yes	#413832
	60A	1	Yes	#413836
Universal Cell	10A	2	Yes	#413828
	10A	2	No	#413830
	60A	1	Yes	#413840

For more information, please refer to Appendix A.

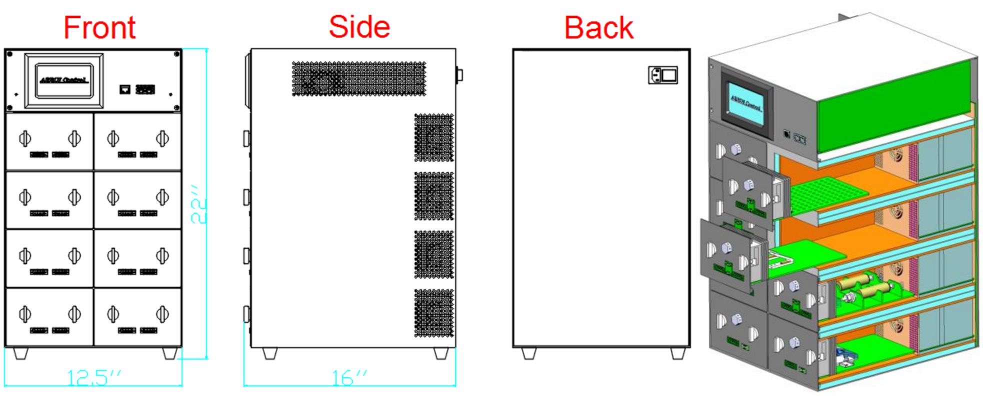


Figure 19-57 Mechanical Drawing

Figure 19-58 Multiple MZTCs with Different Rack Configurations (2/3/4/6)

19.4.4 Frequently Asked Questions for the Multi-Zone Temperature Control Chamber

1. How do I directly monitor the temperature of the battery?

An additional auxiliary PT100 board is required. First, Connect the PT100 temperature sensor to the battery. Then, connect the PT100 temperature sensor to the battery tray. Finally, use a dedicated phoenix-4-pin to phoenix-2-pin cable to connect the auxiliary PT100 board to the battery tray. Please note that not all battery trays are compatible with PT100 temperature sensors.

2. How many MZTCs can be controlled using the Mits X software?

One computer can control up to 32 MZTCs (256 independent temperature control chambers) simultaneously.

3. Can I change the operation mode from Remote Mode to Local Mode when controlling MZTC through Schedule in Mits X?

No. You cannot change the operation mode from Remote Mode to Local Mode until the test Schedule is completed or stopped.

4. Can I have different battery trays in my MZTC?

Yes, you can use different battery trays for MZTC. Please pay special attention to the mapping on the batch file and the current ratings of the different battery trays.

The following tables show all the different battery trays available for MZTC.

Table 19-2 MZTC Cylindrical Cell Battery Tray Holders

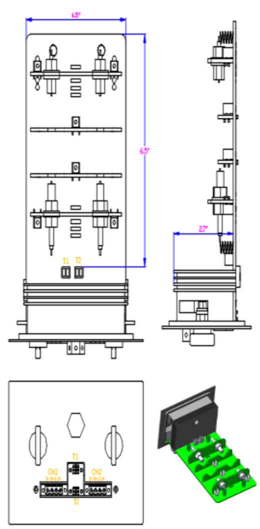
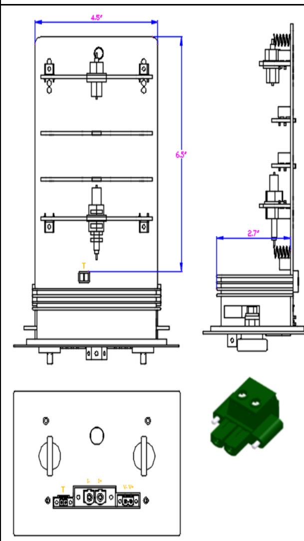
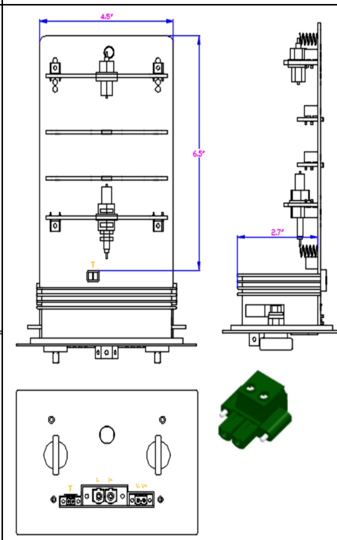
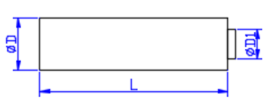
MZTC – Battery Tray Holder – Cylindrical Cell			
MZTC Battery Tray Holder	10A Cylindrical Cell 2CH	30A Cylindrical Cell 1CH	60A Cylindrical Cell 1CH
Arbin Part Number	#413824	#413832	#413836
Maximum Current	10 A	30 A	60 A
Maximum Number of Cells	2	1	1
Thermistor Port Number	2	1	1
Cell Dimensions	18mm≤ØD≤21mm ØD1≥8mm 55mm≤L≤75mm	18mm≤ØD≤21mm ØD1≥8mm 55mm≤L≤75mm	18mm≤ØD≤21mm ØD1≥8mm 55mm≤L≤75mm
Battery Tray Holder Dimensions	W: 4.5 in, D: 6.5 in, H: 2.7 in	W: 4.5 in, D: 6.5 in, H: 2.7 in	W: 4.5 in, D: 6.5 in, H: 2.7 in
Battery Tray Diagram			
Cell Diagram 			
IV Cable Connector	Phoenix-4Pin_5.08-Female Arbin #194922 Phoenix #1810451 	Phoenix-2Pin_10.16+2Pin_5.08-Female Arbin #388066 + #306130 Phoenix #1967456 + #1777989 	Phoenix-2Pin_10.16+2Pin_5.08-Female Arbin #388066 + #306130 Phoenix #1967456 + #1777989 
TC Cable Connector	Phoenix-2Pin_3.81-Female  Arbin #322466 Phoenix #1827703	Phoenix-2Pin_3.81-Female  Arbin #322466 Phoenix #1827703	Phoenix-2Pin_3.81-Female  Arbin #322466 Phoenix #1827703

Table 19-3 MZTC Universal Cell Battery Tray Holders

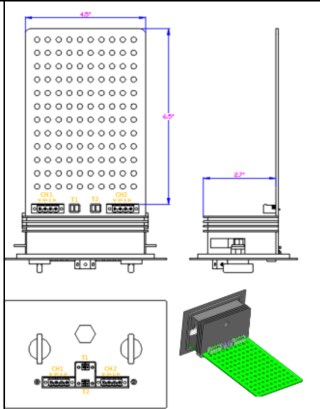
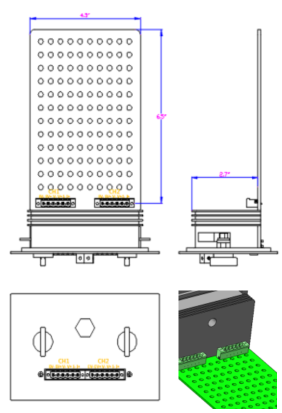
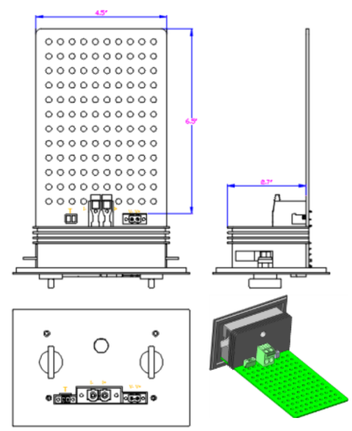
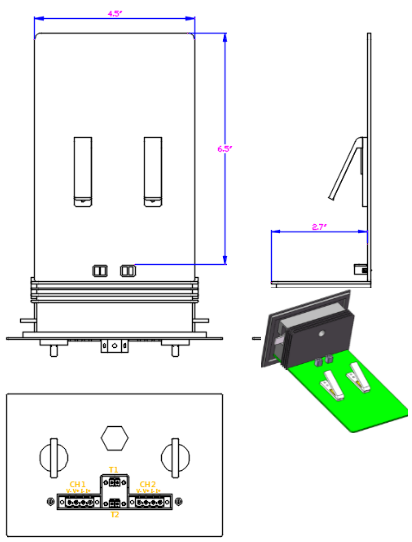
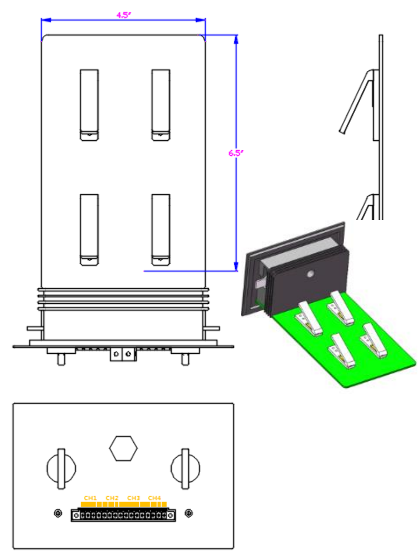
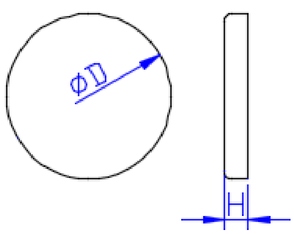
MZTC – Battery Tray Holder – Universal Cell			
MZTC Battery Tray Holder	10A Universal Cell 2CH	10A Universal Cell Three Poles 2CH	60A Universal Cell 1CH
Arbin Part Number	#413828	#413830	#413840
Maximum Current	10 A	10 A	60 A
Max. Number of Cells	2	2	1
Thermistor Port Number	2	0	1
Cell Dimensions	W < 4 in, D < 6.5 in, H < 2.7 in	W < 4 in, D < 6.5 in, H < 2.7 in	W < 4 in, D < 6.5 in, H < 2.7 in
Battery Tray Holder Dimensions	W: 4.5 in, D: 6.5 in, H: 2.7 in	W: 4.5 in, D: 6.5 in, H: 2.7 in	W: 4.5 in, D: 6.5 in, H: 2.7 in
Battery Tray Diagram			
IV Cable Connector	 Phoenix-4Pin_5.08-Female Arbin #194922 Phoenix #1810451	 Phoenix-6Pin_5.08-Female Arbin #316538 Phoenix #1778027	Phoenix2Pin10.16+2Pin5.08Female Arbin #388066 + #306130 Phoenix #1967456 + #1777989
TC Cable Connector	 Phoenix-2Pin_3.81-Female Arbin #322466 Phoenix #1827703	None	 Phoenix-2Pin_3.81-Female Arbin #322466 Phoenix #1827703

Table 19-4 MZTC Coin Cell Battery Tray Holders

MZTC – Battery Tray Holder – Coin Cell		
MZTC Battery Tray Holder	5A Coin Cell 2CH	5A Coin Cell 4CH
Arbin Part Number	#413820	#413822
Maximum Current	5 A	5 A
Maximum Number of Cells	2	4
Thermistor Port Number	2	0
Cell Dimensions	10mm≤ØD≤30mm H≤7mm	10mm≤ØD≤30mm H≤7mm
Battery Tray Holder Dimensions	W: 4.5 in, D: 6.5 in, H: 2.7 in	W: 4.5 in, D: 6.5 in, H: 2.7 in
Battery Tray Diagram		
Cell Diagram 		
IV Cable Connector	 Phoenix-4Pin_5.08-Female Arbin #194922 Phoenix #1810451	 Phoenix-16Pin_3.81-Female Arbin #381546 Phoenix #1827842
TC Cable Connector	 Phoenix-2Pin_3.81-Female Arbin #322466 Phoenix #1827703	None

20: Troubleshooting

20.1 Troubleshooting Connection Schemes

Verify that the system is ready for performance by conducting the following channel diagnostic procedure (Figure 20-1) to check the Mits X system control.

20.1.1 Current Diagnostic Connection Scheme

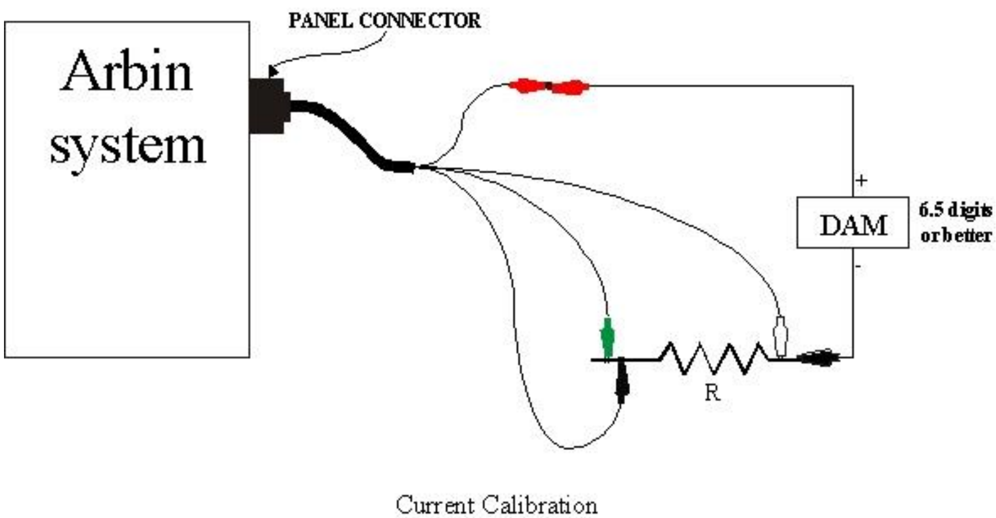


Figure 20-1 Current Diagnostic Connection Scheme

1) Make the connection shown in the figure above on Channel N. R should be between 0.01 and 0.05 ohms.
2) Start Mits X and click the "Calibration" button for hardware calibration.
3) On the Calibration Interface, choose the options as shown below. Then, use the mouse cursor or the <tab> key to move the fields:

Start Chan: N, Chan Count: 1, IRange1, Units: 1x.

4) Enter "0" as the Desired Value.
5) Click the "Set" button, and the red LED of channel N will light up.
   a) Once this condition is verified, proceed with the Desired Value as specified by Table 20-1.
   b) Failure in this step indicates trouble with the system communication. Contact Arbin Customer Service for hardware troubleshooting support.
6) Read the value on the ammeter and enter it with the appropriate sign in the "Accurate Values" field.
7) Click the "Calculate" button. The calibration Interface will display the Machine Value. Then, enter the appropriate parameters into the diagnostic data report.
8) Click the "Next" button.

20.1.2 Voltage Diagnostic Connection Scheme

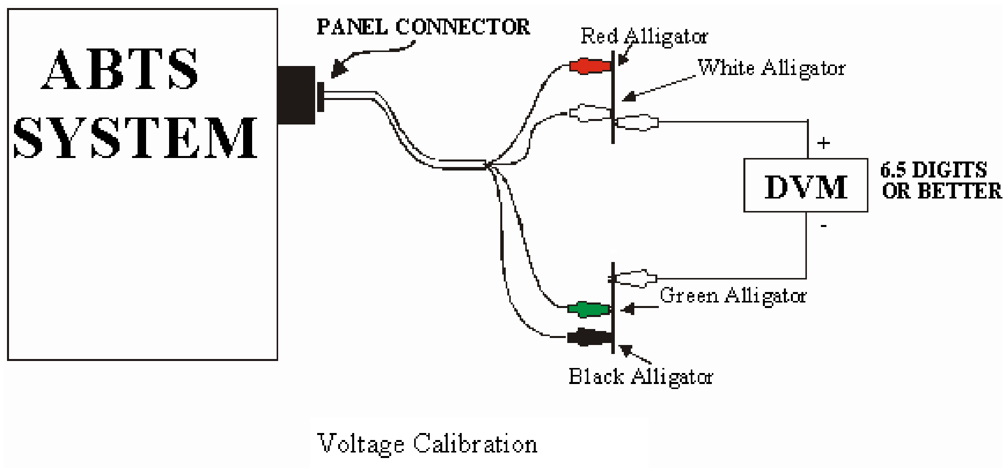


Figure 20-2 Voltage Diagnostic Connection Scheme, For the System with Hardware Voltage Control Only

1) Change the connection to match the scheme shown above.
2) Verify the settings:

Start Chan: N, Chan Count: 1, Voltage-High, Units: 1x.

3) Enter 1/5–1/2 of the full range value as the desired value for the range. Then, click the "Set" button.
4) Read the value on the voltmeter and enter it with the appropriate sign in the "Accurate Values" field.
5) Click the "Calculate" button. The machine value will display on the calibration Interface.
6) Repeat steps 3 through 5 for every data point required, entering the appropriate information in the Accurate value field.
7) Click the “Calculate” button. The calibration Interface will display the Machine Value. Next, enter the appropriate parameters in the diagnostic data report.
8) If the differences between the "Desired Value," "Accurate Value," and the "Machine Value" are less than the tolerance (0.1% of full scale), then the system is performing satisfactorily to specification. Otherwise, fill out the following forms (Form 20-1 and Form 20-2) and report the problem to Arbin Customer Service.
9) Click "Next" and close the Calibration Interface.

NOTE: Never click the “Done” button unless you are told to do so by technical support personnel from Arbin Customer Support! Doing so will overwrite all the calibration data.

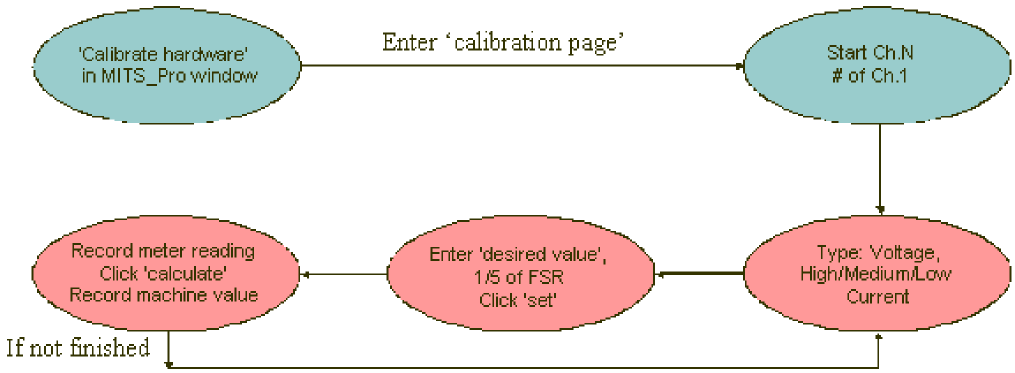


Figure 20-3 Procedure to Report Channel Problem

Table 20-1 Channel Diagnostic Form for High Range

	Desired Value	Meter Value	Machine Value
1/5 of FSR (H), Voltage			
1/5 of FSR (H), Charge Current			
1/5 of FSR (H), Discharge Current			

Table 20-2 Channel Diagnostic Report on Channel N, Range X

Channel Number:__ Current, Voltage, other Range: __

Desired Value	Accurate Value	Machine Value

20.2 Troubleshooting Hints

Symptom 1: No green board LEDs light after turning on the Arbin cycler with the computer off.

Possible Causes:

1) Arbin cycler power is off.
2) The 3-phase protector does not function properly.
3) The fuse on AC main power is blown.

Solution:

1) Check the building power supply.
2) Check the voltages of 3-phase lines and adjust the pot on the 3-phase detector.
3) Check if the Arbin cycler's fans are running to verify if the main fuse is blown.

Symptom 2: All channel red LEDs do not follow the command, with the computer and green LEDs on.

Possible Causes:

1) Channel runs in the "Rest" step.
2) The computer is not communicating with the Arbin cycler.
3) Control DC power supply failure.
4) The Mits X software has stopped due to some operation problems.
5) Mits X software has stopped due to some problems with the defect file in HD.
6) Internal ribbon cable in the Arbin cycler fails.

Solution:

1) It is normal.
2) Check the data cable connection between the computer and the Arbin cycler. (Also, check the Arbin interface card in the computer.)
3) Check the voltage on the control DC connector and check the fuse.
4) Check the taskbar and see if the DAQ and LOG tasks are running. If either one has been accidentally closed, a system reboot will be necessary.
5) Open the control panel/devices to see that all the drivers are present in the system. If not, please call Arbin to reinstall the Mits X software.
6) Contact Arbin Customer Support.

Symptom 3: The red LEDs on the 4 channels of a board did not follow the command.

Possible Causes:

1) Incorrect jumper setting on the module.

Solution:

1) Call the factory for further assistance.

Symptom 4: The channel red LEDs follow the command, but only a single channel delivers the micro/milli Amperes charge and discharge current.

Possible Causes:

1) Channel fuses F1 and/or F2 has blown.

Solution:

1) Pull the module out. Check the fuse and replace it if it is blown. F1 affects all ranges; F2 affects middle and low ranges, but not high ranges.

Symptom 5: The channel red LEDs followed the command. But the channel only delivered micro/mA current on all channels of one board.

Possible Causes:

1) DC main power fuse(s) has(have) blown.

Solution:

1) Measure the voltage and check the fuse for DC main power (red wire for charge and white wire for discharge).

Symptom 6: The channel red LEDs followed the command, but the channel only delivered micro/mA current on all channels of the Arbin cycler.

Possible Causes:

1) DC main power supply failure.

Solution:

1) The positive part is for charge current. The negative part is for discharge current. Contact the factory for instruction.

Symptom 7: No fan noise can be heard, but the unit works properly for a while and then shuts down.

Possible Causes:

1) Fan fuses are blown, and the unit is tripping off on thermal override.

Solution:

1) Replace fan fuses or fans.

Symptom 8: Fans work correctly, but the current drops to a much lower value after it momentarily reaches the desired value.

Possible Causes:

1) A defective FET.

Solution:

1) Check the FET chips, which are attached to the aluminum heat sink. Inspect for any visible damage. Then, call the factory for further assistance.

Symptom 9: Red LED works, but current and voltage fluctuate irregularly on all channels.

Possible Causes:

1) Defective DC main power supply.
2) Bad ground connection.

Solution:

1) Check the ground connection between the power supply and chassis.
2) Measure the voltage fluctuation on the DC main power supply.

Symptom 10: Red LED works well, but current and voltage fluctuate irregularly on 8 channels of a board.

Possible Causes:

1) Bad connection between the power supply and the channel board.
2) Bad connection on the channel board.

Solution:

1) Check all the connection points from DC main power supply through the board.
2) Press all chips on the channel board to ensure firm connections.
3) Call the factory.

Symptom 11: Current control works correctly, but a voltage spike occurred on all 8 channels of a board.

Possible Causes:

1) Defective internal ribbon cable or a defective 9-pin communication cable.
2) Defective microcontroller board.

Solution:

1) Replace serial cable.
2) Call the factory for repair or replacement.

Symptom 12: Current control works correctly, but a voltage spike occurred on a single channel.

Possible Causes:

1) Defective microcontroller board.

Solution:

1) Contact Arbin Customer Support for repair or replacement.

Symptom 13: System communication looks OK, but the actual value or display value is different from the desired value.

Possible Causes:

1) The system configuration file, ArbinSys.cfg, has an error or was corrupted.
2) Calibration is required.

Solution:

1) Check the system configuration through the MITS Interface.
2) Replace it from the backup CD onto the D:\MITS_X if something wrong is found in ArbinSys.cfg.
3) Re-calibrate the system every year, or in case of abnormal values, re-calibrate to bring the system back into conformance.

Symptom 14: After a power outage, an error message displayed while the system tried to reestablish communication.

Possible Causes:

1) The computer system has hung somewhere.
2) The GAL or EPROM chips in the Arbin cycler were damaged.
3) A program file has been damaged.
4) AC input or DC control power fuse blown.

Solution:

1) Restart the computer.
2) Contact factory.
3) Re-install Mits X.
4) Replace fuses.

Symptom 15: With no power outage, communication cannot be re-established.

Possible Causes:

1) A new schedule in the working batch has a logic error.
2) A wrong key strike caused the system to jam.

Solution:

1) Verify that windaq.exe is open and running correctly.
2) Under the command line Interface of the operating system, ping the IP address of MCU. If it cannot be connected, it may be the fault of MCU, or the IP address of MCU is set incorrectly.
3) Check the IP address inConsole.exe is the same as the address in WinDaq.exe.
4) Restart the computer or re-install the software of Mits X.

Symptom 16: The test control runs correctly for a while then gets interrupted or runs slower.

Possible Causes:

1) The result file, ArbinSys.res, is too large or contains too many entries.
2) The Schedule is not compatible with the cell; it was outside control limits.
3) The hard disk drive is full.
4) Virtual memory is too small.

Solution:

1) Delete or modify the wrong test program.
2) Copy old files to disk or save to another computer via network and delete from Arbin computer to make room.
3) Go to "Control Panel/System" to increase the virtual storage space to 200MB.

Symptom 17: Channels do not follow the schedule properly after resuming the test.

Possible Causes:

1) File identification information was lost due to the power failure or computer failure, which initially interrupted the test.

Solution:

1) When resuming channels after a power failure, computer outage, or other incidents which force the DAQ application to close, one must resume the channels individually and select a specific file (test name) to write the data. When resuming after such a failure, the user should not select "same as last test" because when DAQ was closed during the test, the computer lost the information necessary to perform this function properly.

Symptom 18: An error message appears at startup, for example, “Could not open the system configuration file using default values.”

Possible Causes:

1) Some files used by MITS do not appear in the correct directory.

Solution:

1) In the Explorer, check all the files in the D:\MITS_X directory. The path of each file is displayed as shown in Table 20-3.

Table 20-3 Mits X File Directory and Path

Directory Name	Storage Location	File Name
Work	C:\ArbinSoftware\MITS_X\	Console.exe, DAQ.exe, ArbinSys.cfg
System	C:\ArbinSoftware\MITS_Pro\Work(\...)	all mapping files (*.bth) all schedule files (*.sdx)
Data	C:\Interfaces\System32	Registry codes and system linking files (*.dll)
DataWatcher Directory	C:\ArbinSoftware\DataWatcher	DataWatcher.exe
Support Directory	C:\ArbinSoftware\MITS_Pro\Support	All Auto calibration files; online edited schedule files, Data log information

NOTE: If any of these files are misplaced, please call Arbin Customer Support.

20.3 FAQs about Arbin Testing Systems

20.3.1 General Questions

1. What is Mits X?
MITS is short for Multiple Integrated Testing System. "X" means the latest version of the software. It is designed for Interfaces 7 and Interfaces 10 operating systems.

20.3.2 Hardware Questions

1. How do I connect the battery being tested to the channel cables?

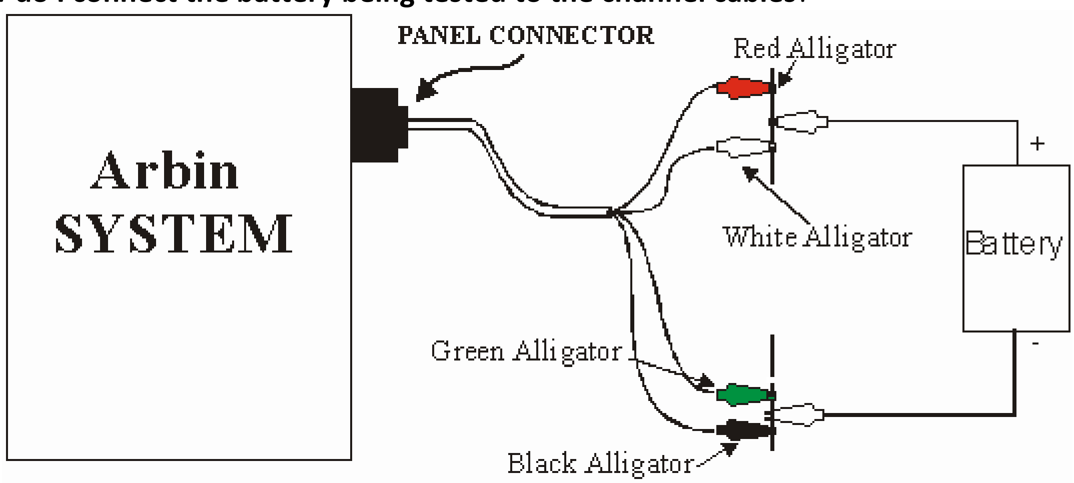


Figure 20-4 Battery Connection Scheme

The Red and White alligator clips connect to the battery's positive terminal, and the Green and Black alligator clips go to the battery's negative terminal (as shown in Figure 20-4).

2. How do I connect the electrochemical components to the channel cables?
The Red and White alligator clips connect to the Working Electrode, the Green alligator clip connects to the Reference Electrode, and the Black alligator clip connects to the Counter Electrode.

20.3.3 About the Mits X Software

1. How fast does Mits X acquire data?
First of all, let us clarify several terminologies referenced by the following software engineers.

- **Data Sampling** – The process of getting data from Arbin instruments.
- **Data Logging** – The process of saving data from the real-time buffer to the results database file.
- **Data Acquiring** – The overall process of data sampling and data logging.

Data sampling and data logging are two independent processes. The MC executes data sampling, and its rate is determined mainly by the time required to sample all operating channels. Data logging is executed in the foreground scan loop. Whenever a schedule limit is evaluated, the data will have its chance to be saved to the results file. If the logging data speed is faster than sampling data speed, there is a chance of saving duplicate data.

Usually, customers will mention "acquire data." However, for us, it stands for two independent processes. So, the question "How fast can Mits X acquire data?" actually is the combination of two questions: "How fast can Mits X log data?" and "How fast can Mits X sample data?"

2. How fast can Mits X log data?
There is no straightforward formula to calculate the speed. However, we provide an answer based on tests. Keep it in mind: if you want a fast-logging speed, be sure to set a big enough logging buffer in the system configure.

3. How fast is the Mits X sampled data?
There is no straightforward formula to calculate the speed either.

For regular 2ADC systems (two ADCs and eight channels on each board), every time Mits X updates current and voltage for all channels once, one auxiliary data will be updated. Here is a rough formula for calculating auxiliary data sampling speed:

Total Seconds of updating all auxiliary data once = 0.2 * the total number of auxiliary data channels.

4. How much RAM does Mits X need?
First of all, there is no formula to calculate the exact amount of RAM that Mits X needs. However, here is a rough guideline:

More than 256MB is needed if the total channel number is greater than 64 or intensive data logging is required.

5. Should we take any precautions while installing a JAZ or ZIP drive and software?
So far, there is no conflict between ZIP drive and JAZ drive. Please contact Arbin customer service with questions about specific devices.

6. After I shut down and restart channels, the data in the results file shows readings of 0 Volts and a 0 current. Is the cell on an open circuit, or is channel reading an artifact of the system/software?
NOTE: Such occurrences make good event markers.

The software is responsible for giving control commands and sampling data back to the hardware. The software is not aware of whether the whole instrument is powered on or not, and it is not aware of whether the circuit is open or not either.

There is only one exception: if the hardware is connected to a UPS and the UPS is correctly configured in Arbin configuration file. Then when Mits X is running, it can check the UPS status and turn all channels off if the power failure signal from UPS is detected.

7. Will we be able to update future editions of Mits X on site?
As software revisions usually involve new features, there are often firmware updates associated with the change. These modifications may be made easily by the customer, but users must be aware that the updates must be affected concurrently with one another. Therefore, always ask about the possibility of a firmware change when inquiring about software updates.

8. What is statistical data in the result file?
Statistical Data is information specially designed for battery testing procedures that involve executing many charge-discharge cycles for a battery. It provides a data summary of each cycle and includes each cycle's last data point, consisting of current, voltage, capacity, and energy. The maximum voltage of each cycle is also tracked and included in the statistical data.

NOTE: Statistical Data implies the use of the Control Type Set Variable(s) with an appropriate Goto Step designation (Figure 20-5 and Figure 20-6). If no such control is defined in a schedule, no data will be presented in the statistical datasheet.

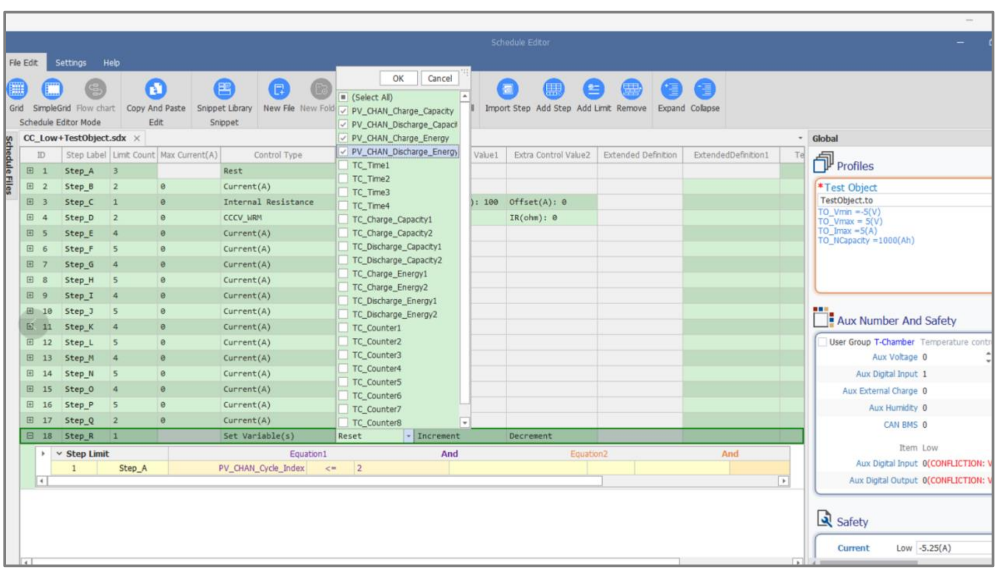


Figure 20-5

EXAMPLE: A cycle test needs to count the charge capacity and discharge capacity for each cycle.

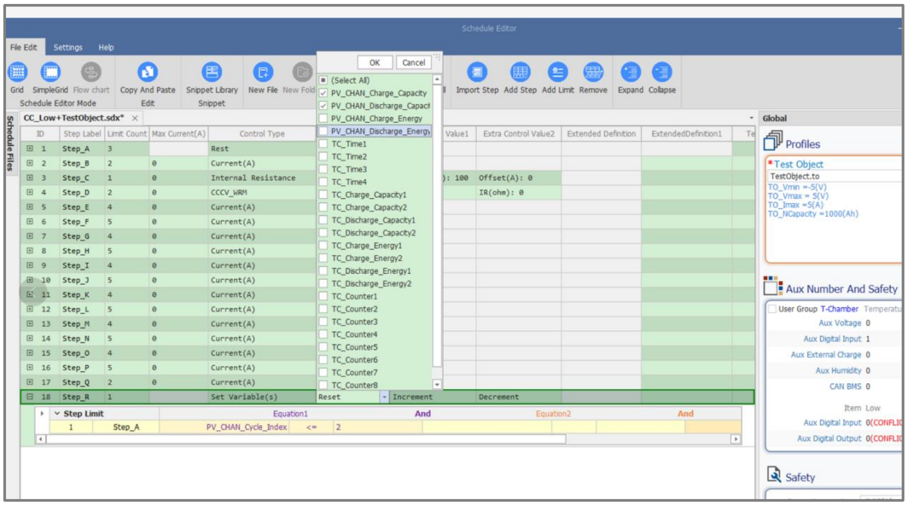


Figure 20-6

9. What is Set Variable(s)? How does this function work?

Set Variable(s) can be considered as a special control mode. It is purely a software function, and no hardware operation is involved. There are three functions associated with this control type:

1) **Reset** – Checking the box corresponding to the parameter will reset this parameter. The parameters include charge capacity, discharge capacity, charge energy, discharge energy, time counter, capacity counter, energy counter, and other value counters. These counters will be activated automatically when the test starts and continue to accumulate as the test proceeds.
2) **Increment** – Checking the box that corresponds to the parameter will increase this parameter by 1.

EXAMPLE: Checking the box corresponding to the cycle index will add 1 to the total cycle number (Figure 20-7).

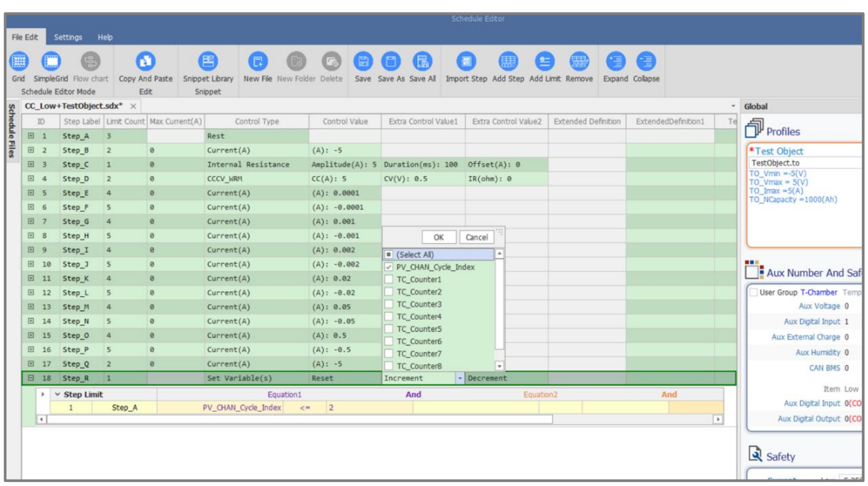


Figure 20-7

NOTE: A cyclic test needs to count the cycle numbers as the test proceeds.

3) **Cut Back** – This function works the same as adding, except it subtracts 1 from the total. For example, when the time counter 1 performs decrement, the original value of tc_counter1 is 4, and the software calculator reduces the value to 3.

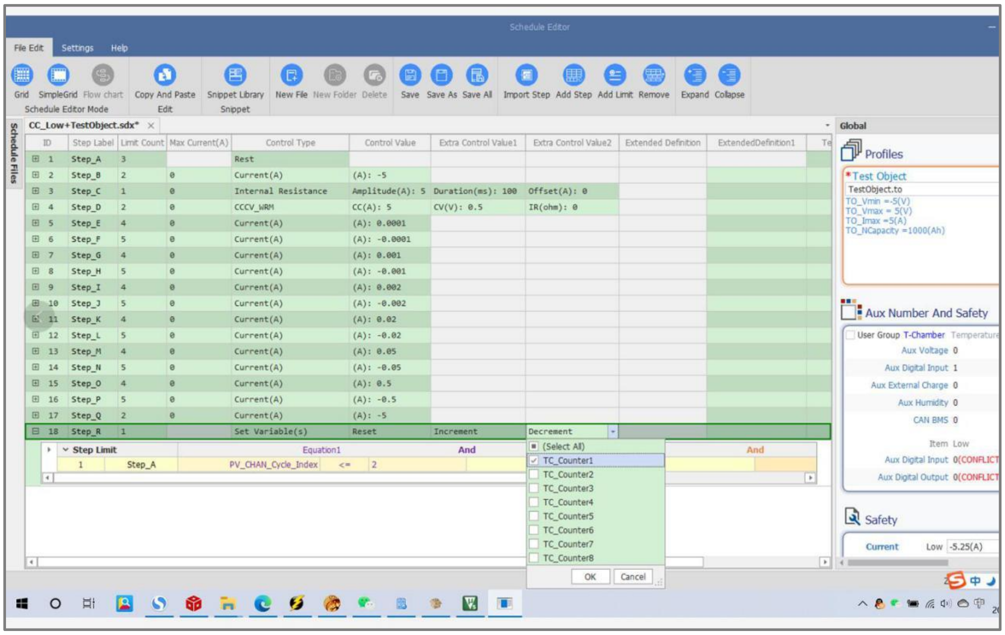


Figure 20-8

10. Why does the cycle number remain 1 during a cycle test?

In a Schedule, one must add a Set Variable(s) step to the end of the cycle and check the PV_Chan_Cycle_Index in the Increment field. Moreover, the Goto Step designations in the Schedule must reflect some cyclical movement within the Xchedule.

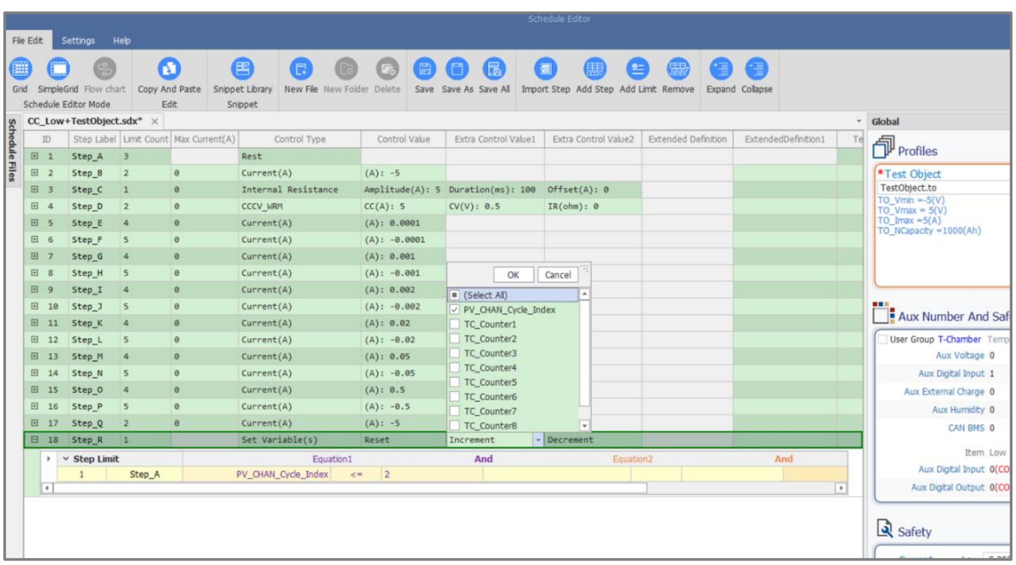


Figure 20-9

11. What are TC_Time1, TC_Time2, TC_Time3, and TC_Time4?

TC_Time1, TC_Time2, TC_Time3, and TC_Time4 are time counters. Time counters can be used to count the total test time of a group of steps. Further, the time counters can be used as the step termination limit or logging data limit.

EXAMPLE: A charging process consists of two steps, a constant current following a constant voltage. The termination condition of this charging process is total time = 5 hours.

To program this charging process:

1) Reset the time counter at the beginning of the charging process, e.g., TC_Time1.
2) Set the TC_Time1 >= 5 hours as the step termination condition for the second step of the charging process.

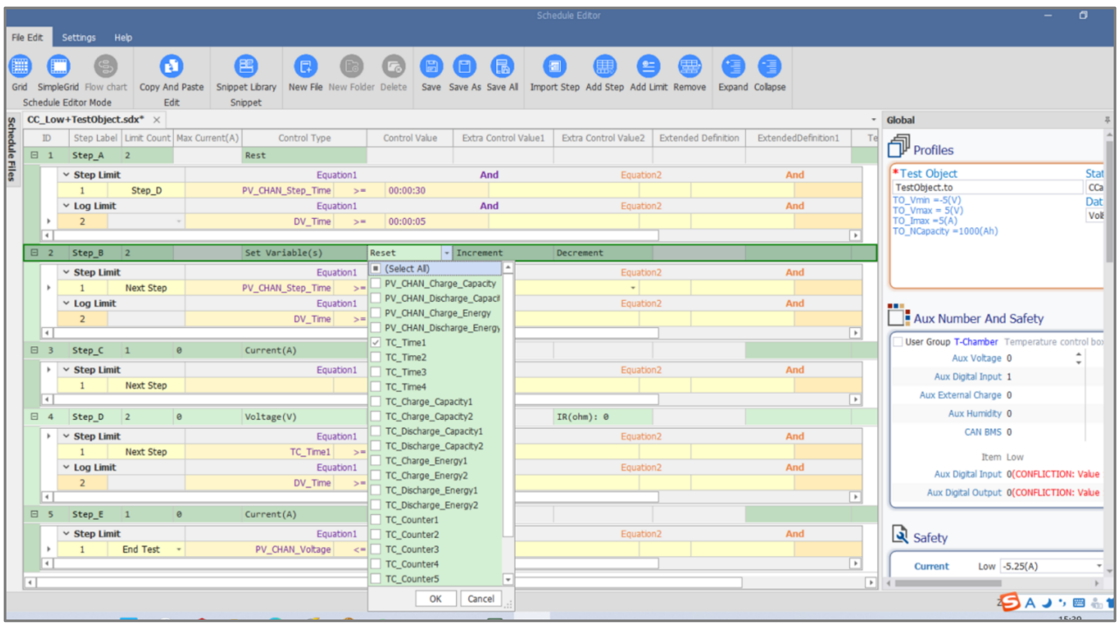


Figure 20-10

12. What are TC_Charge_Capacity1, TC_Charge_Capacity2, TC_Discharge_Capacity1, TC_Discharge_Capacity2, TC_Charge_Energy1, TC_Charge_Energy2, TC_Discharge_Energy1, and TC_Discharge_Energy2?

- TC_Charge_Capacity1 and TC_Charge_Capacity2 are charge capacity counters. The charge capacity is the capacity when the current is positive.
- TC_Disharge_Capacity1 and TC_Disharge_Capacity2 are discharged capacity counters. The discharge capacity is the capacity when the current is negative.
- TC_Charge_Energy1 and TC_Charge_Energy2 are charge energy counters. The formula calculates the charging energy by I*V*dt when the current is positive.
- TC_Discharge_Energy1 and TC_Discharge_Energy2 are both discharge energy counters. The formula calculates the discharge energy by I*V*dt when the current is negative.

The user can apply the capacity counters and the energy counters when the individual step or a group of steps needs to be counted separately. In most cases, the capacity or energy counters are used as the step termination condition or logging data condition.

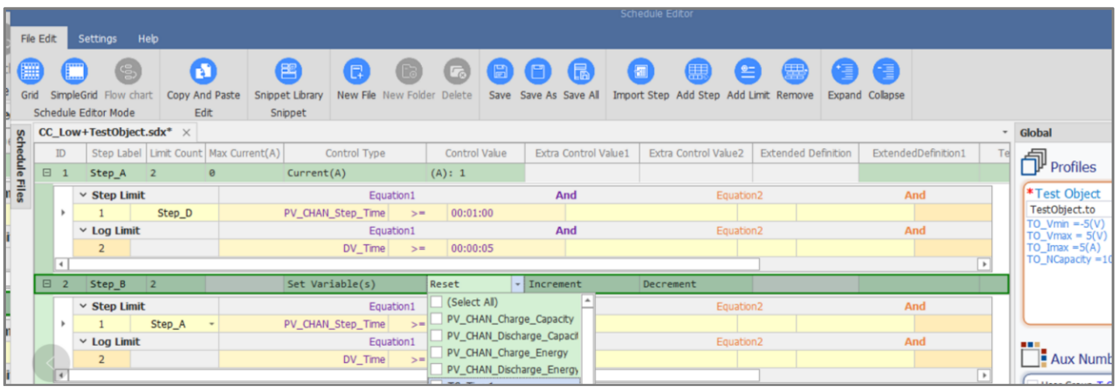


Figure 20-11

13. How does one implement cyclic voltammetry (CV) on the Arbin test system?

While some of the phenomena in this response are consistent with the latest MITS technology, users should note that CV Control implemented most easily with CV methodology.

Some users try to run Cyclic Voltammetry on Arbin test system. Under certain conditions, a fluctuated current curve may accompany a seemingly linear voltage ramp. However, it may not fit or may not be ready for some particular experiments.

Due to the nature of the digital control in our current product, a voltage ramp consists of numerous tiny stairs (Figure 20-12, left).

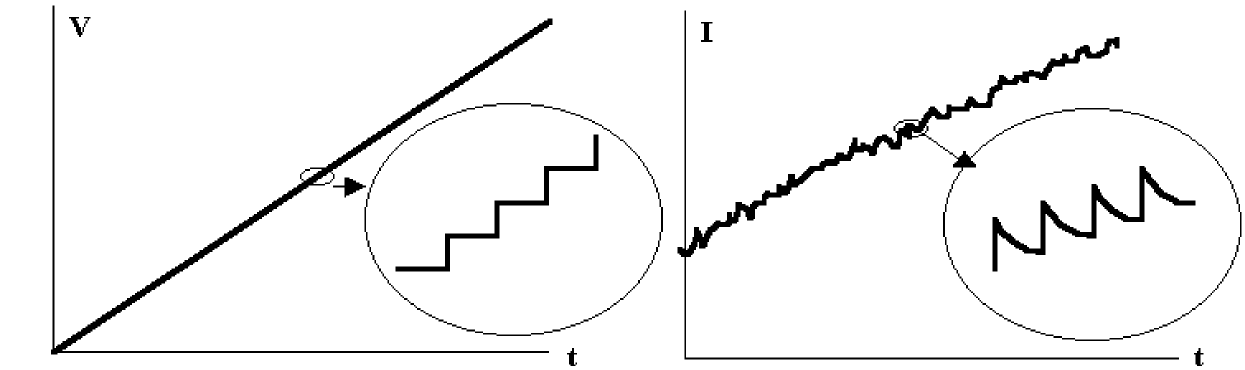


Figure 20-12

The height of one stair is: Hstair = full-scale FSR of the voltage range / 216 (16-bit ADC word)

Or Hstair = full-scale FSR / 224 (24-bit ADC word) of the voltage range.

EXAMPLE: Consider the LBT21 series with the voltage range of -100V to +100V. The full-scale range (FSR) of the voltage is 200V, and Hstair is 3.1mV. Therefore, this instrument would not be capable of producing a CV with a scan rate any slower than 3.1 mV/second.

Furthermore, when the linear voltage scan is invoked, the system generates a stair-like function. The voltage rising or drop related to each stair on an electrochemical device will introduce the current response in a pattern similar to that shown in the chart above, right.

Here is an example of how a CV has been historically scheduled in MITS software:

1) Select "Voltage Ramp(V)" as the control type to generate a voltage ramp function.
2) Enter the starting potential in the Control Value field.
3) Enter the scan rate (sweep rate) in the Extra Control Value 1.
4) Set the termination condition for the ramp.
   a) Users can use current, voltage, time, capacity, etc., to terminate the ramp function.
   b) Figure 20-13 shows a voltage ramp, starting from 0.1V, ending at 1.0V, and the scan rate is 20mV/sec.

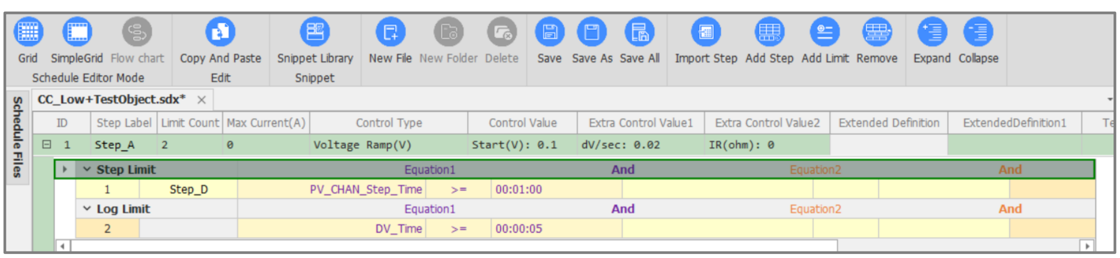


Figure 20-13

NOTE: Mits X contains an embedded Control Type for single-step definition and implementation of voltametric and galvanometric sweeps. More information about this new CV Control could be found in **6.8 Program Cyclic Voltammetry**.

The same procedures apply to the generation of the current ramps.

14. How is the Current Staircase function used?

Current Staircase can generate the following function (Figure 20-14).

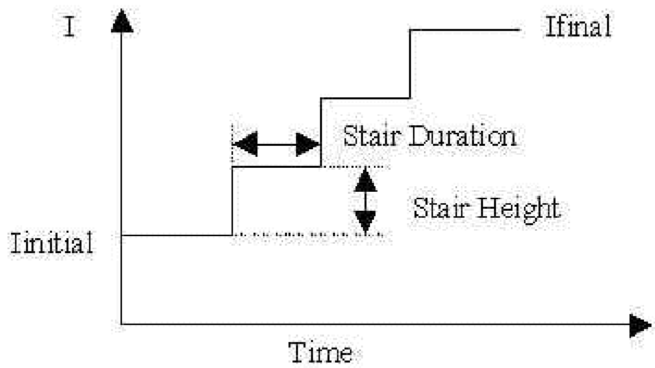


Figure 20-14

EXAMPLE: Starting from 0.5 A, increase current 50mA every 20 seconds until the current reaches 2.0A. To program this function, select the control type as Current Staircase. Enter 0.5 in the Control Value field and 0.050A in the Extra Control Value1 field, and 20s in the Extra Control Value2 field. Set the termination condition as in the following picture.

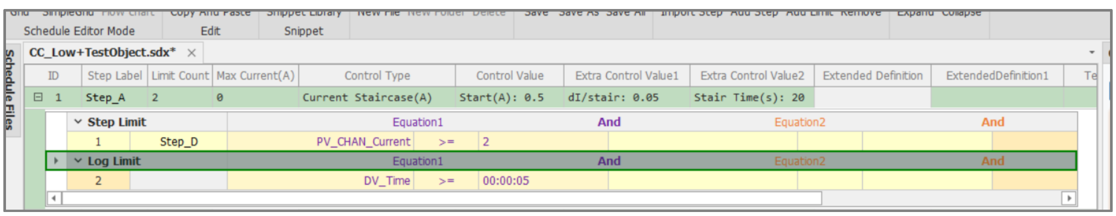


Figure 20-15

15. Why does voltage overshoot during voltage control?

In the current Arbin system, the function of the voltage limit is controlled through the software rather than through specialized circuitry on the board. During data acquisition, a delay time is experienced with respect to limit checking. In the earlier ABTS software, this delay time on single-channel was about 200ms. Furthermore, this condition was exacerbated with increased channel activity. With a system containing 64 to 128 channels, the delay time could reach 1-2 seconds.

Under certain conditions, where voltage increases rapidly, crossing the limit value, such delay could cause the voltage to overshoot.

EXAMPLE: A fully charged battery has an initial voltage of 4.09V. The voltage limit was set at 4.1V for a step with 1.0C constant charge current. Under this relatively high charge current, voltage overshoot is definitely expected.

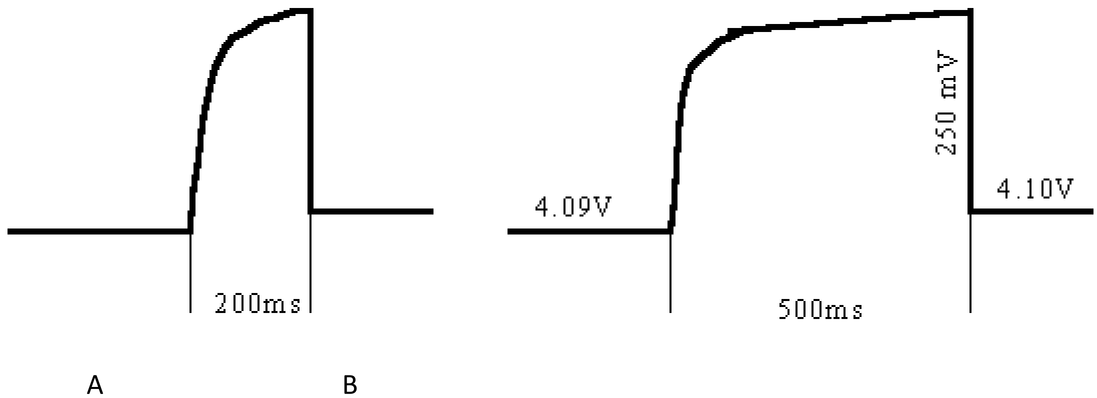


Figure 20-16

Figure 20-16 above shows voltage overshoot during constant 1C current charge (A) with voltage limit 4.1V, (B) with time limit 0.5s. ABTS 4.0 and 2ADC machine. You could observe this on an oscilloscope.

The question is how fast the software can cut off the overshoot. The shorter the delay of the limit checking, the lesser the overshoot will be. For example, if the delay time is 1-2 seconds, it will cause several hundred millivolts overshoot.

With our new software, Mits X, the limit checking on a single channel is faster than ABTS 4.0. It takes about 100 milliseconds. The advantage of Mits X is that the delay time of the limit checking changes slightly with running channels. Therefore, under Mits X control, the risk of voltage overshoot will be reduced.

In this case, several approaches can be employed to eliminate the overshoot. The first option is to decrease the constant charge current, i.e., from 1.0C to 0.1C. The lower charge current generates slower voltage rising and much smaller voltage overshoot. Therefore, select a lesser current if the initial voltage difference is close to the voltage limit. The second option is to use the formula to schedule a tailed current continuously in one step.

$$\mathbf{I = (V_{limit} - V_{present}) * F \quad (1)}$$

The value of factor F must be determined through several tests and varies with the type of battery. As the present voltage approaches the voltage limit, the current value will be decreasing. An actual schedule is shown in Figure 19-17.

Step 1. ‘Rest’ for 10 seconds.

Step 2. ‘Formula I control’ with voltage limit V limit.

Step 3. ‘Constant V’ for 30 seconds.

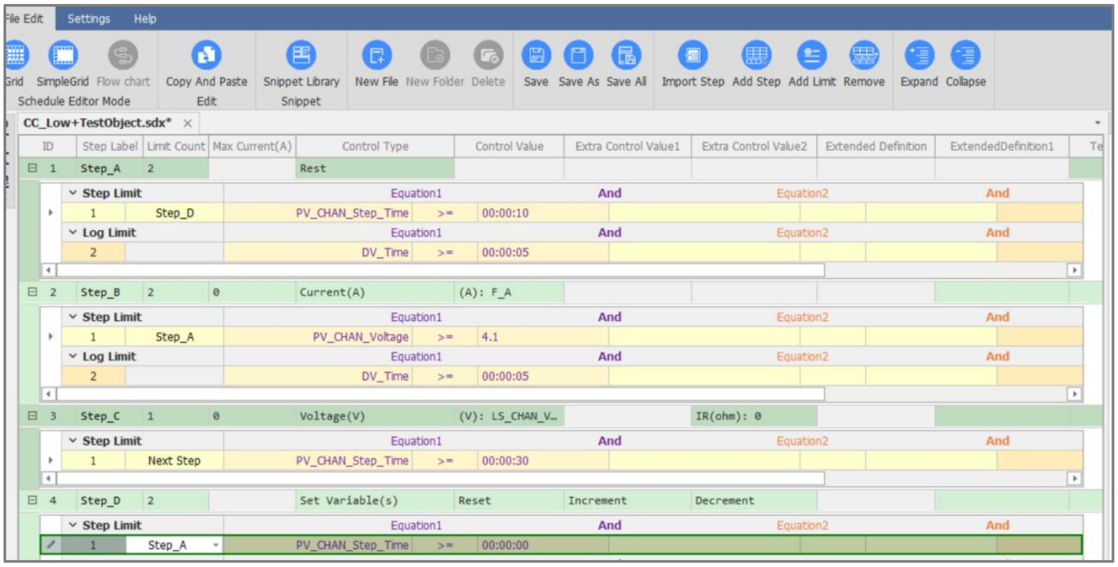


Figure 20-17

A schedule with V limit = 4.1V, F = 1.35 for 100 cycles
(In Formula_A, X1 = 4.1, X2 = 1.35, X3 = X4 = 1; Y1 = V present, Y2 = 1.35, Y3 = Y4 = 1)

An additional improvement is implemented in this example. Instead of commanding a Control Value of 4.1V, the nominal cutoff for step 2, a metavariable, is chosen. By selecting LS_CHAN_Voltage (Read "last step channel voltage"), the software will maintain the last value that triggered the step termination and avoid the discontinuity that the voltage feedback loop would otherwise create by assuming a distinct decimal value.

16. Why does the system shut down by itself?

Several reasons: power failure, lightning strike, circuitry failure, computer failure, etc. All of the conditions can cause interruptions of Arbin systems. Also, software defects (Read "bugs.") are a possible cause to freeze the system. Despite continuous effort expended toward software debugging, most commercial software still has minor bugs. Even though Interfaces is a well-recognized [purportedly stable] operating system, minor bugs still exist there, too.

For the safety of the Arbin Arbin cycler and the device tested, Arbin hardware and software have many safety provisions to protect from such problems.

- Current-limiting circuitry to prevent current from exceeding the maximum current range when shorted.
- Watchdog to turn off the system in a few seconds after CPU hangs up or communication breaks down, whether a software bug or hardware connection causes it.
- For modules over 2A, a thermal switch may shutdown channels to prevent overheating from abnormally large current or breakdown of cooling fans.
- Optional UPS (uninterruptible power supply) that prevents data loss or system damage from power failure.

- Software safety limit – There are safety limits of current, voltage, auxiliary voltage, temperature, and pressure for the whole test in each Schedule. Whenever the limit exceeds, the channel will exit the test.
- Software step limit – In each step of a Schedule, there can be limits of any variable(s) or Meta Variable(s) set for termination of the step or the test.

In case of system shutdown, first check all hardware, external connection, internal fuses, and components. Then, fix the hardware problem or report the issue to Arbin Customer Support for further assistance.

If there is no obvious hardware problem, the operator may try to close the Arbin software through Interfaces Task Manager, turn on the Arbin cycler, and restart the software. In most cases, the system can be restored, and the test will be successfully resumed. However, avoid rebooting the computer as much as possible, since sometimes this action may prevent tests from being resumed.

If there are problems found with current or voltage control after the system shuts down, do not calibrate the channel. Instead, check the fuse(s) first.

17. What causes current spikes in constant voltage control?

A current spike may occur on a present Arbin system during the transition from a constant current (I) step with voltage limit, V_{limit}, to a constant voltage step $V = V_{limit}$. Several factors can cause such a spike, among them, the internal resistance of the device.

Arbin instrumentation provides voltage accuracy of 0.02% of the full-scale range (FSR). For example, for an **LBT21** series with a voltage range of –10 to +10V, FSR 20V, the error of the voltage control could be 4 mV (dV). For a device with an impedance of 10 milliohms (dR), such voltage error could cause a current spike.

$$\mathbf{I = dV/dR = 0.4\ A}$$

The voltage accuracy is a factor to introduce the spike. Second, under certain conditions, the battery status changes quickly from one data point to another, particularly when the current in the charge step is close or greater than at 1C rate. The difference between the last point in the current step and the first point in the voltage step could reach tens of milliVolts. This voltage difference also can cause a current spike during the transition from constant current control to constant voltage control. Using 'LastValue' instead of the exact value for voltage control may reduce the problem from wrong timing of transition but not from changing the status of the battery.

Several approaches can be employed to reduce the current spike.

1) Decrease the constant charge current to reduce the voltage difference caused by battery status change. Select a lesser current if the initial voltage difference is close to the voltage limit.
2) Use the formula to schedule a tailed current continuously in the current step. If a current spike triggers a current limit in the voltage step, the test may be stopped. Users could edit an ‘AND’ condition with a time limit to accompany the current limit, such as

I < 20mA AND t > 1 second in the voltage step or use PV_CHN_CVStage_Current <20 mA

It allows the test to run continuously.

18. What is C-Rate? How to use C-Rate in control testing？

C-Rate is a common reference for indicating the discharge and charge current of a battery. It can be expressed as:

$$I=M*C$$

In this formula, I = current (A); C = capacity of battery (Ah); M is the C-rate value.

1) In Mits X, enter the battery rated capacity in the Object Files.
2) Enter the nominal capacity value in the Capacity (Ah) field using the C-Rate control. The software will calculate an output current value automatically.
3) Positive C-Rate refers to charge current and negative C-Rate refers to discharge current. For example, if the cell's capacity being tested is 1.2Ah, and the C-Rate value was set to 0.5, then the output current should be 2.0´0.5=0.6A.

Alternatively, quantities for **Specific Capacity (Ah/g)** and **Mass (g)** may be entered into the table to calculate the nominal capacity for a given sample.

E.g., 0.023g of doped carbonaceous material bears a Faradaic equivalent of 0.315Ah/g. Thus, entering these values results in a calculated capacity of 0.023´0.315=0.0072Ah that would subsequently be used to determine the C-Rate as above.

<Test Object File Window> TestObject.to

Item	Description	Value
*Imax	Maximum Current(A)	2
*Vmin	Minimum Voltage(V)	-12
*Vmax	Maximum Voltage(V)	12
*NCapacity	Nominal Capacity(Ah)	0.0072
Mass	Mass(g)	0.023
SCapacity	Specific Capacity(Ah/g)	0.315
NIR	Nominal Internal Resistance(Ohm)	0
NVoltage	Nominal Voltage(V)	0
NCapacitance	Nominal Capacitance(F)	0

Figure 20-18

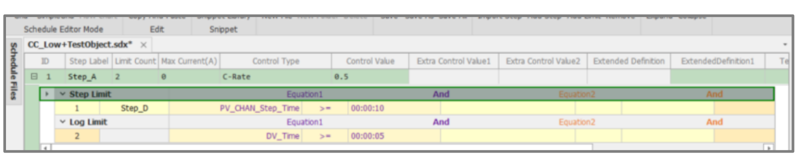


Figure 20-19

19. What does dV mean?

$$dV = V - V_{max}$$

Here, V represents the present measured voltage value. V_{max} represents the measured maximum voltage during a test. dV is designed to be used as the termination condition for the charging process of Ni-MH or Ni-Cd cells. For a Ni-MH or Ni-Cd cell, a complete charge process is signaled by the drop in voltage of the cell after the cell voltage reaches its maximum value (See Figure 20-20).

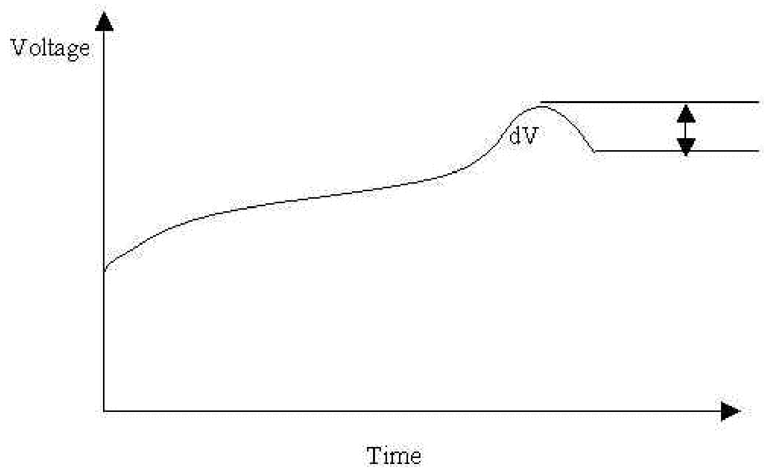


Figure 20-20

20. What does dV / dt mean? How is this parameter used as a termination condition?

$$dV/dt = (V2 - V1) / (t2 - t1)$$

V2 is the voltage measured at time t2. V1 is the voltage measured at time t1.

EXAMPLE: To charge a cell at 1A to the voltage change of 100mV per second.

In Mits X, the dX represents the rate of change of voltage, dt represents the time interval with minimum and maximum values.

NOTE: The Voltage Range in dX field is based on the ArbinSys.cfg.

Item	dX(minimum)	dt(minimum delta time of calculation)	dt(maximun delta time of calculation)
dV / dt	0.2% * Voltage Range	0.1 (S)	120 (S)

Figure 20-21

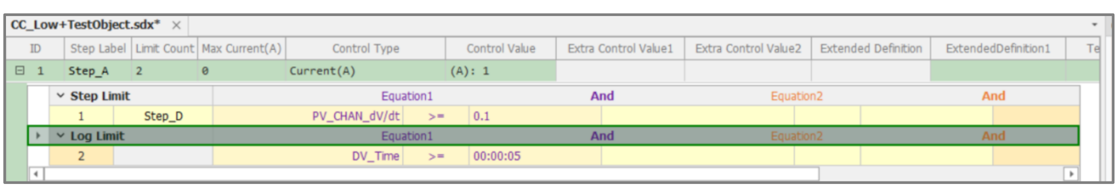


Figure 20-22

21. What does dT / dt mean? How is this parameter used as a termination condition?

$$dT/dt = (T2 - T1) / (t2 - t1)$$

T2 is the measured temperature at time t2.

T1 is the measured temperature at time t1.

EXAMPLE: If the temperature is> 38°C, charge the battery to dT / dt = 2.5°C/sec.

Add Limit		Goto Step	Variable1	Operator1	Value1	Variable2	Operator2	Value2
Step Limits	1	Next Step	AV_dT/dt[1]	>=	2.5	AV_T[1]	>=	38

Figure 20-23

NOTE: Parameter [1] means that the temperature value quoted in this limit will be the number reported by the thermistor or thermocouple auxiliary channel index 1.

22. When trying to assign a test program, the test program file listed in (C:\ArbinSoftware\MITS_PRO\Work) disappears?

The test program files listed in C:\ArbinSoftware\MITS_PRO\Work disappear when assigning a test program (Figure 20-24).

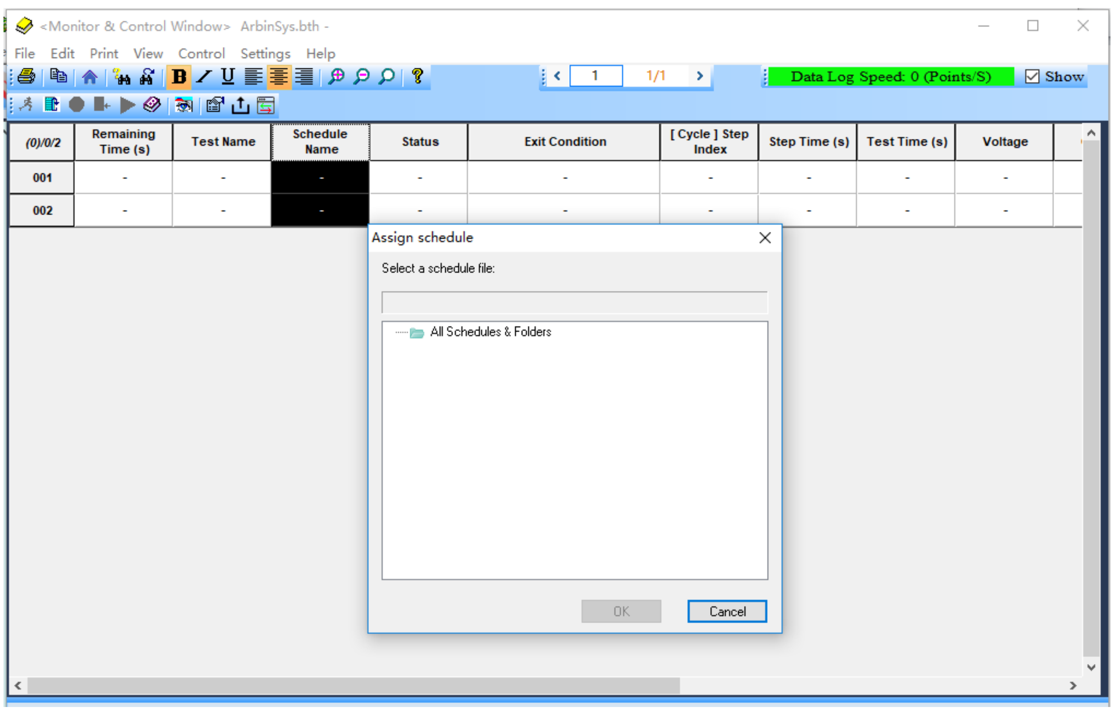


Figure 20-24

This occurs when the "For a quick search, allow indexing service to index this folder" box has not been checked. This option is located in the advanced properties of the folder\ArbinSoftware properties (Figure 20-25).

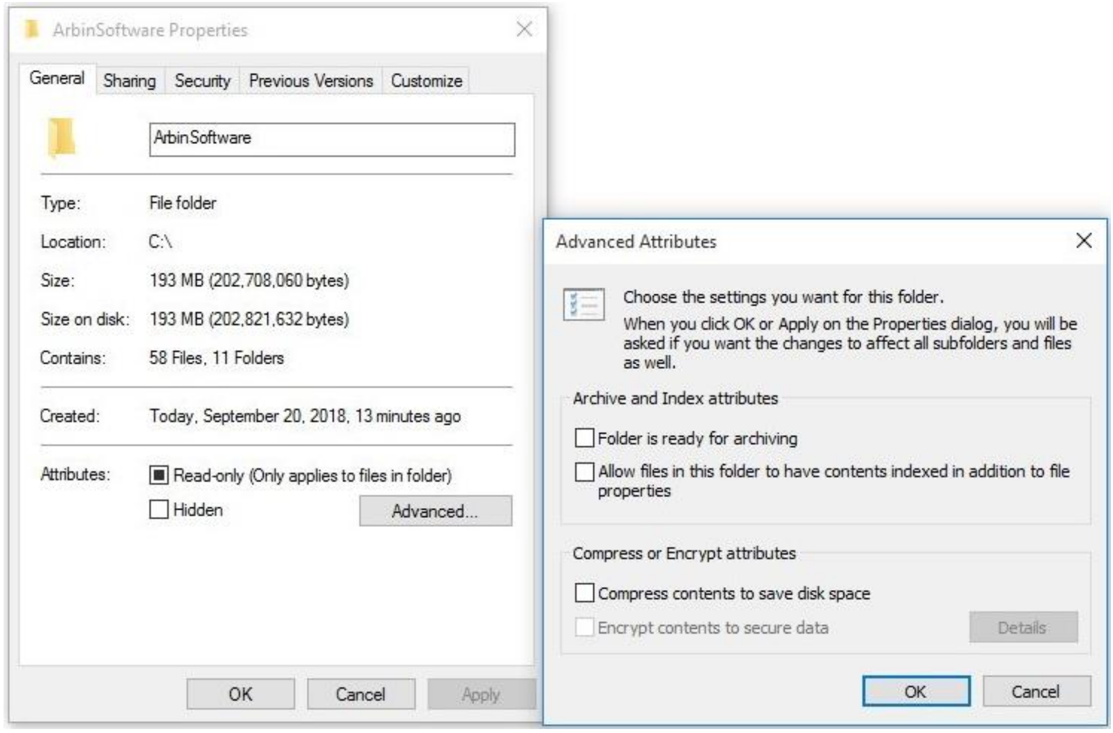


Figure 20-25

1) Right-click on the folder \ArbinSoftware.

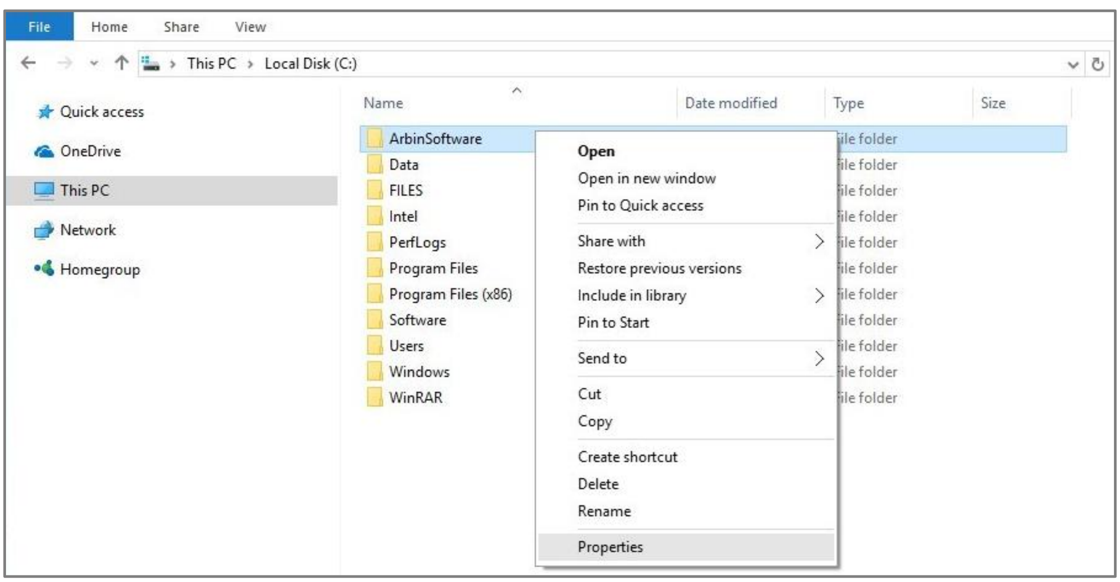


Figure 20-26

2) Then, click "Properties."
3) Go to "General" and click "Advanced." The "Advanced Properties" Interface will appear.

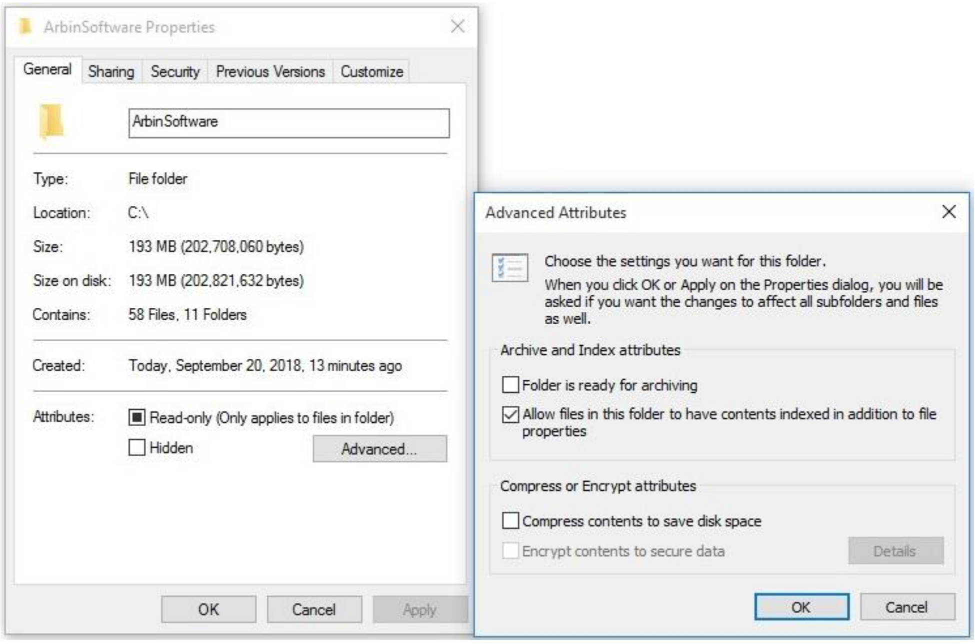


Figure 20-27

4) In the "Advanced Properties" Interface, check the "Allow files in this folder to index content in addition to file properties" box. Then, when trying to assign a test program, you can see the listed test program files (see below).

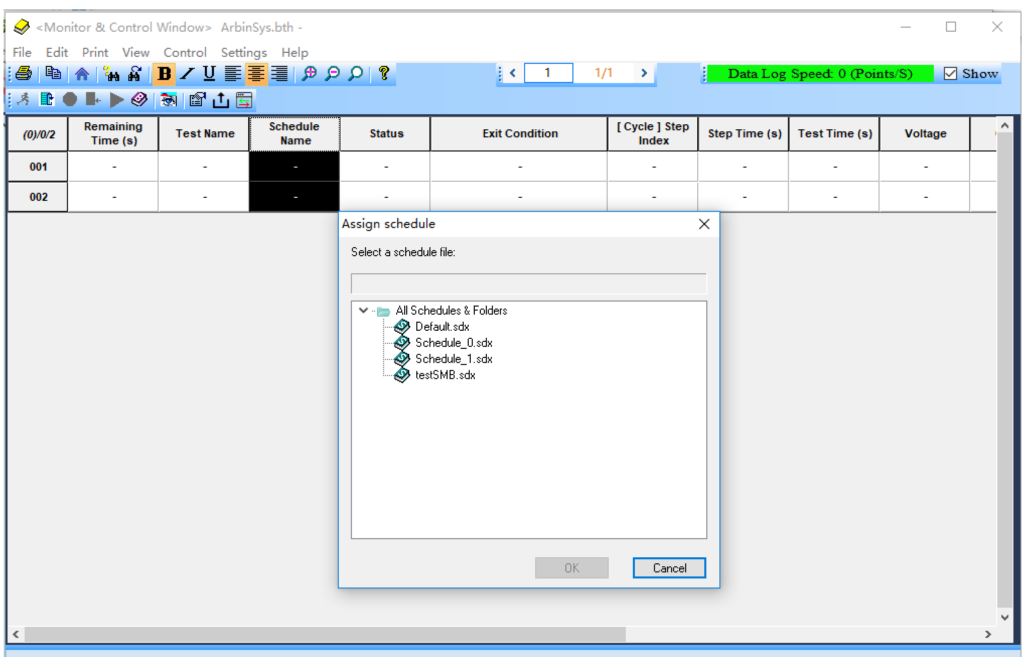


Figure 20-28

Defects and Solutions of Mits X:

For any found defects, contact Arbin Customer Support to resolve them.

Appendixes

Appendix A: Control Type Function Description

Control Type	Function
Current (A)	Output a constant current to the battery according to the set value. A positive value is charging, and a negative value is discharging. Allow channels to be connected in parallel.
Voltage (V)	Output a constant voltage to the battery according to the set value. Allow channels to be connected in parallel.
C-Rate	C-rate is a common test method for discharging and charging batteries. Expressed as I=M*C. Among them: I=current A, C=battery capacity, M=C-rate value To use C-rate control, you need to enter the battery's calibrated capacity in the Test Object File and fill in the C-rate value under the (Schedule) Control Value. A positive C-rate is charging, and a negative value is discharging. C-rate can be used in parallel.
Rest	The battery is disconnected from the charge/discharge circuit, but is still connected to the voltage measurement circuit, so the open circuit voltage can be measured.
Pause	When the Test executes one Step Pause, until the Resume button is pressed, no data is recorded, or the relay is switched on and off. This control type has no Limit.
Power (W)	Output constant power to the battery according to the set value. According to Ohm's law: V=IR and P=IV, interactively measure the voltage and calculate the required current to realize the constant power control set by the user. Every time the channel samples data, through calculation, the current quickly stabilizes at the desired power value, and changes with the voltage to maintain the power value. Parallel channels can be used.
Load (Ohm)	Perform a constant load test on the battery according to the set value. In the constant load test, the current is always discharged. Parallel channels can be used.
Set Variable(s)	Change the variables related to the experiment, including channel capacity, energy, and all experiment counter variables. Clicking on the checkboxes in front of these variables will change the corresponding values. The variable can be reset to 0 or increased or decreased by 1 each time. Capacities and Energies can only be reset and cannot be increased or decreased. Charge_Capacity – Channel charge capacity Discharge_Capacity-channel discharge capacity

	Charge_Energy – Channel charging energy Discharge_Energy-channel discharge energy TC_Time1-Time counter 1 TC_Time2-Time counter 2 TC_Time3-Time counter 3 TC_Time4-Time counter 4 TC_Charge_Capacity1-Experimental charging capacity counter 1 TC_Discharge_Capacity1-Experimental discharge capacity counter 1 TC_Charge_Capacity2-Experimental charging capacity counter 2 TC_Discharge_Capacity2-Experimental discharge capacity counter 2 TC_Charge_Energy1-Experimental charging energy counter 1 TC_Discharge_Energy1-Experimental discharge energy counter 1 TC_Charge_Energy2-Experimental charging energy counter 2 TC_Discharge_Energy2-Experimental discharge energy counter 2
Current Ramp (A)	In order to generate a current ramp, fill in the initial value in Control Value, and fill in the scan rate per second in Extra Control Value 1. A positive scan rate generates a rising current ramp, and a negative scan rate generates a falling current ramp. Parallel channels can be used.
Voltage Ramp (V)	To generate a voltage ramp, fill in the starting value in Control Value, and fill in the scan rate per second in Extra Control Value 1. A positive scan rate produces a rising voltage ramp, and a negative scan rate produces a falling voltage ramp. Parallel channels can be used.
Current Staircase (A)	To generate a current ladder, fill in the starting value in Control Value, fill in a step increase in Extra Control Value1, and fill in the duration of a step in Extra Control Value2. A positive increment (dI/Stair) produces an ascending current ladder, and a negative dI/Stair value creates a descending current ladder. Parallel channels can be used.
Voltage Staircase (V)	To generate a voltage ladder, fill in the starting value in Control Value, fill in a step increase in Extra Control Value1, and fill in the duration of a step in Extra Control Value2. A positive increment (dI/Stair) produces a rising voltage ladder, and a negative dI/Stair value produces a falling voltage ladder. Parallel channels can be used.
Current Pulse (A)	During the test, a predefined current pulse is generated. Click Extended Definition, and then select the assigned pulse file from the drop-down menu. The user needs to create a pulse file in the pulse page first. Refer to section **6.7 Program Pulse Control**.
Current Simulation	The ASCII data stream format can be used as an external data source to realize the function of non-standard time domain for the control parameters of each test. For details, refer to **Chapter 8 The Simulation Editor**. This function is not applicable to parallel channels.
Load Simulation	Reference current simulation. This function is not applicable to parallel channels.

Power Simulation	Reference current simulation. This function is not applicable to parallel channels.
Battery Simulation	Using this type of control, when a simplified theoretical battery model is available, the Arbin device acts like an actual battery in a large number of applications. A simplified battery model used in this simulation contains the relationship between two factors, namely, the open circuit voltage and the DC internal resistance corresponding to the state of charge. This function is not applicable to parallel channels.
External Charge	An external charger connected to the provided input will control the charging/discharging of the battery. Arbin test equipment samples data, performs real-time monitoring and records data in the database. There is no control data to be filled in in Schedule.
Internal Resistance	This function generates 10 pulse trains of *1ms pulse width with a defined pulse amplitude [+ or -] for a constant current charging or discharging step. Calculate $\Delta V/\Delta I$ and record the data directly in the data file. *Some Arbin test equipment provides variable Pulse width. Contact Arbin Customer Support for details.
Current CycleV (A)	This mode allows the user to create a linear scan in one step without skipping steps to reverse the scan direction. For more information, see section **6.8 Program Cyclic Voltammetry**.
Voltage Cycle (V)	This mode allows the user to create a linear scan in one step without skipping steps to reverse the scan direction. For more information, see section **6.8 Program Cyclic Voltammetry**.
CCCV	See above.
CCCV_WRM (With Relaxation Method)	Allow the user to realize the constant current and constant voltage charging state in one step through this control mode. The user specifies the charging current (CC(A):) and voltage limit (CV(V):) at one time. Charging can be terminated by time or current limit. Please note that this control type is only applicable to specific hardware configurations. This type can be used for parallel channels.
Write CAN Messages	Write value to CAN Bus. Control type: write CAN information Control value: the period of continuous sending of CAN messages Extra Control Value1: CAN message ID Extra Control Value2: CAN information data. Information byte 0 to message byte 7, separated by spaces. Extended Definition: CAN message data length (DLC: 0-7), frame type (0: standard, 1: extended), stop one (0: no, 1: yes), all stop (0: no, 1: yes), Separated by spaces. Send messages to CAN BMS frequently.
Write Signal Specified CAN Message	Control value: the period of continuous sending of CAN messages

	Extra Control Value1: CAN message ID, derived from the CAN file Outbound CAN Signal Specified Message. Extended Definition: CAN message data length (DLC: 0-7), frame type (0: standard, 1: extended), stop one (0: no, 1: yes), all stop (0: no, 1: yes), Separated by spaces. Send messages to CAN BMS frequently.
Write SMB Register	Write text data to the SMBus writable register.
Write SMB Register (String)	Write the ASCII string to the SMBus writable register.
Write SMB Block	Use the SBS command to write to the SMB block.
Set SMB Opt Word Address	The Vcell address of the first cell to which the smart battery is allocated.
Current_TB (Turbo Boost)	Specify the batch charging current (dynamic change) (DC) and voltage limit (dynamic change) (DV). Charging can be terminated by time or current limit. Please note that this control type is only applicable to specific SMB hardware.
CCCV_TB	The CCCV turbo boost (Turbo Boost (CCCV_TB)) function adds a discharge current pulse to the normal CCCV charge, starting from 0% RSOC to 100% RSOC. Switch from CC to CV by the given highest charging voltage. CCCV_TB control type has six control values-CC (A), CC pulse width (ms), DC (A), current range, DC pulse width (ms), CV (V). CC (A): Charging current value. It must be a positive value to set the charging current of the battery. CC Width(ms): CC pulse width (ms): duration of charging current. The duration of the charging current before the discharge pulse. It must be ≥10ms. DC (A): Pulse value of discharge current. It must be a negative value to set the discharge current pulse. DC Width(ms): DC pulse width (ms): pulse width of discharge current. It must be ≥10ms. CV (V): The voltage target value in the constant voltage stage. It must be a positive value.
Voltage (Digital)(V)	A constant voltage is output to the battery at a specified value. Digital voltage control will provide you with a smoother transition from current control to digital voltage control. Digital voltage control is not suitable for open circuit voltage control and potentiostatic type control. Please note that this control type is only available for specific hardware.
SetValue(s)	16 new Meta Variables can be customized on each TestObject. These Meta Variables can be pre-defined or edited in the test program for reading the values in the test.
DO Setting	Turn on or off the digital output of the channel.
ACR	Calculate V/I and record the data in the result file.
Internal Resistance (Alternative)	This function applies a 10-pulse train with a *1ms pulse width of the specified amplitude [+ and -] after the constant current charging or

	discharging step. Calculate DV/DI and record the data directly in the result file. *Some Arbin testers provide variable pulse widths. Contact Arbin Customer Support for clarification.

Appendix B: Meta Variable Function Descriptions

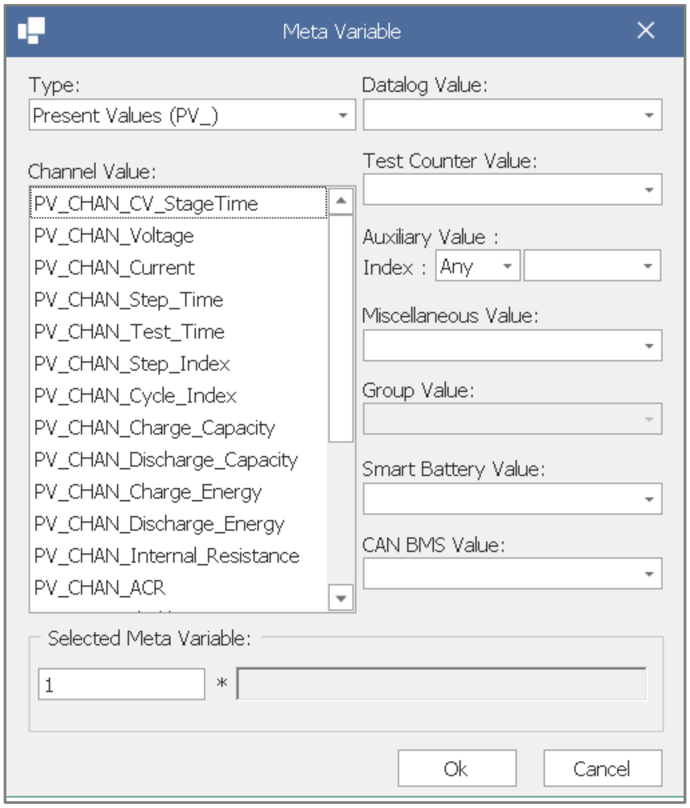


Figure B-1 Meta Variable Interface

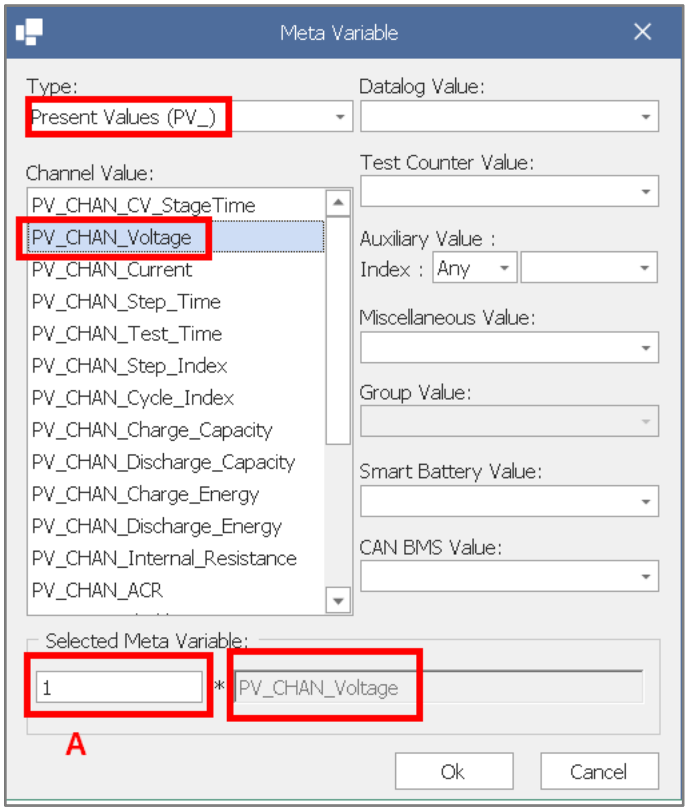
Meta Variables can be divided into seven categories:

1) Variables related to the channel
2) Variables related to data logging
3) Variables related to test count
4) Variables related to auxiliary measurement
5) Multiple numerical variables
6) Variables related to smart batteries
7) Variables related to CAN BMS Channel-related variables

1: Channel-Related Variables

The channel-related variables refer to those parameters associated with the specified channel. Select the current value in the Type drop-down box.

E.g.:



In this picture, the meta variable type is Present Values (PV_), and the parameter is CHAN_Voltage. The final selected meta variable is PV_CHAN_Voltage, which represents the voltage value in the data buffer of the current running channel. The position A is the coefficient of the current voltage value, which can be set by the user.

Meta variables related to channels can be further divided into three types:

Parameter	Definition
Present Values (PV_)	The current measurement value.
Last Step Values (LS_)	The value when the previous step is switched to the current step.
Last Cycle Values (LC_)	The previous cycle switches to the value at the current cycle.

Parameters related to the channel:

Parameter	Definition
CHAN_CV_StageTime	Control the CV constant voltage charging time under CCCV_WRM, and jump directly after reaching the time set by this parameter instead of continuing to charge according to Step Time.
CHAN_Voltage	Measured channel voltage value, unit (V).
CHAN_Current	Measured channel current value, unit (A).
CHAN_Step_Time	The elapsed time calculated from the beginning of a particular step.
CHAN_Step_Index	Step index of the Test Schedule run.
CHAN _Cycle_Index	Cycle index of the currently running Step.
CHAN_Charge_Capacity	The measured channel charging capacity, unit (Ah). Displayed as a positive value.
CHAN_Discharge_Capacity	The measured channel discharge capacity, unit (Ah). Displayed as a positive value.
CHAN_Charge_Energy	The measured channel charging energy value, unit (Wh). Displayed as a positive value.
CHAN_Discharge_Energy	The measured channel discharge energy value, unit (Wh). Displayed as a positive value.
CHAN_Internal_Resistance	Measured internal resistance.
CHAN_ACR	AC impedance.
CHAN_dV/dt	Channel voltage change rate. See note 1.
PV_CHAN_Pulse_StageAve_Vol	Average voltage of the phase in the pulse step.
PV_CHAN_Pulse_Ave_Vol	Average voltage in the pulse step.
CHAN_AC_Impedance	Measured AC impedance value.
PV_CHAN_VmaxOnCycle	Maximum voltage in a cycle.
PV_CHAN_PulseCycle	Pulse cycle number of pulse step.
UNIT_DI1	Built-in digital output 1 variable.
UNIT_DI2	Built-in digital output 2 variable.
CHAN_Error_IV	CHAN BMS broadcast error IV code. See note 2.
CHAN_Error_AUX	CAN BMS broadcast transmission error AUX code. See note 2.
CHAN_Error_DCDC	CAN BMS broadcast transmission error DCDC code. See note 2.
CHAN_Error_CANBMS	CAN BMS broadcast transmission error CAN BMS code. See note 2.

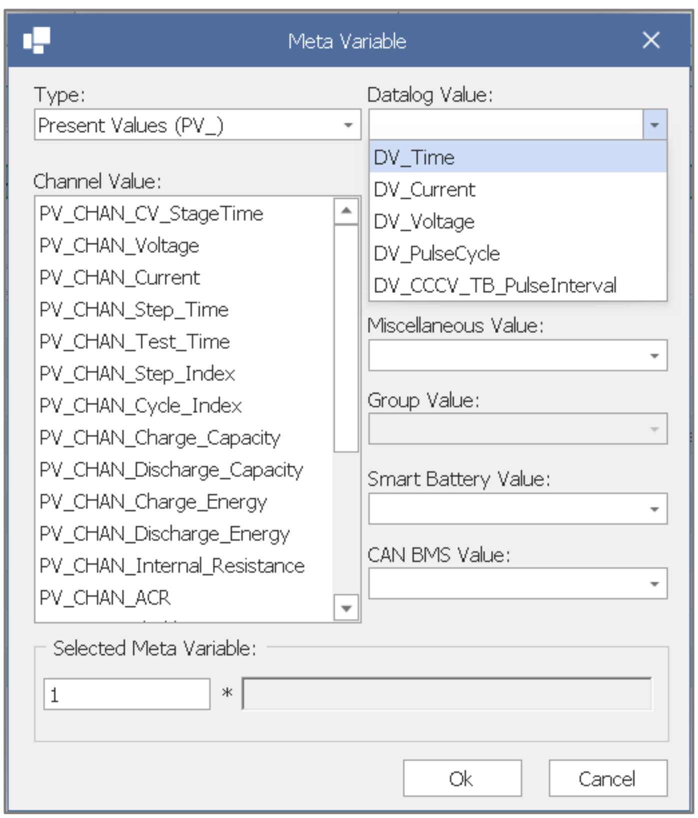
CHAN_Error_SMB	CAN BSM broadcast transmission error SMB code. See note 2.
CHAN_Error_INVERTER	CAN BMS broadcast transmission error INVERTER code. See note 2.
CHAN_VmaxOnCycle	The maximum voltage measured during the test, unit (V).

NOTE 1: dV/dt = (current V-buffer V)/dt. dV/dt is the first-order rate of change of voltage. Current V is the voltage value in the circular buffer. dt is the time interval between the current and the last data point.

NOTE 2: Each type of error occupies 4 bytes, and each type of error occupies 1 bit. That is, each type of error contains a maximum of 32 types of errors. When the variable value is 0, it means that no error occurred.

2: Data Logging Variables

The variable value (Meta Variable) is defined as the condition of recording data. There are three parameters of current, voltage and time variables, as well as the number of pulses and the number of discharge pulses that are only applicable to CCCV_TB type. The user can use equations to create similar variable values of other parameters in the test program, such as temperature, pressure, charge capacity, discharge capacity, etc.



Collected Data-Related Parameters

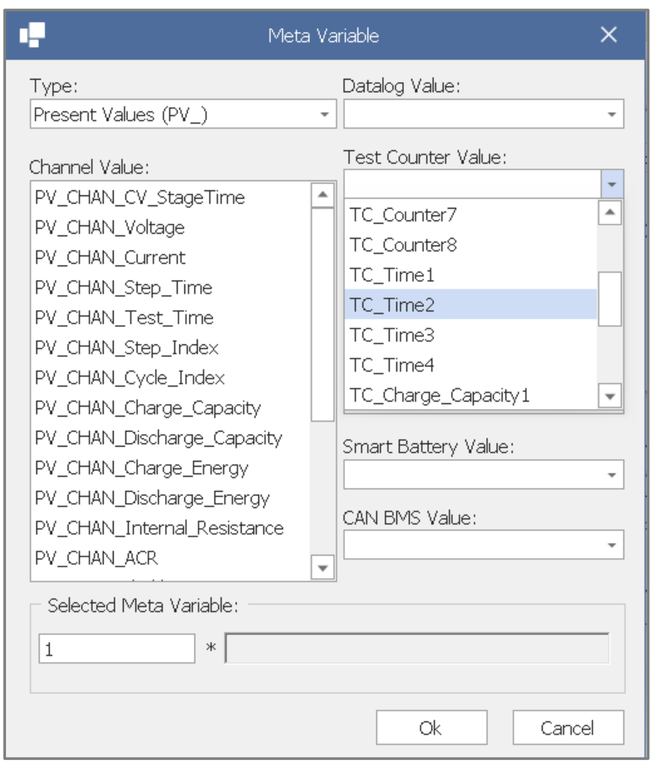
Parameter	Definition
DV_Time	Record two data points according to the time interval.
DV_Current	Record two data points according to the current change.
DV_Voltage	Record two data points according to the voltage change.
DV_CCCV_TB_PulseInterval	Only applicable to CCCV_TB. The lower computer records a complete discharge pulse after a few discharge pulses.

3: Test Counter Variables

The software provides six types of counters:

1) General counter
2) Time
3) Charge capacity
4) Discharge capacity
5) Charge energy
6) Discharge energy

These counters can be activated and reset in any step of the test program, and the counter value can be used as a step termination condition or a data recording condition. When the user does not want to use or reset the main test time, test capacity, test energy or cycle count, these counters will be applied.

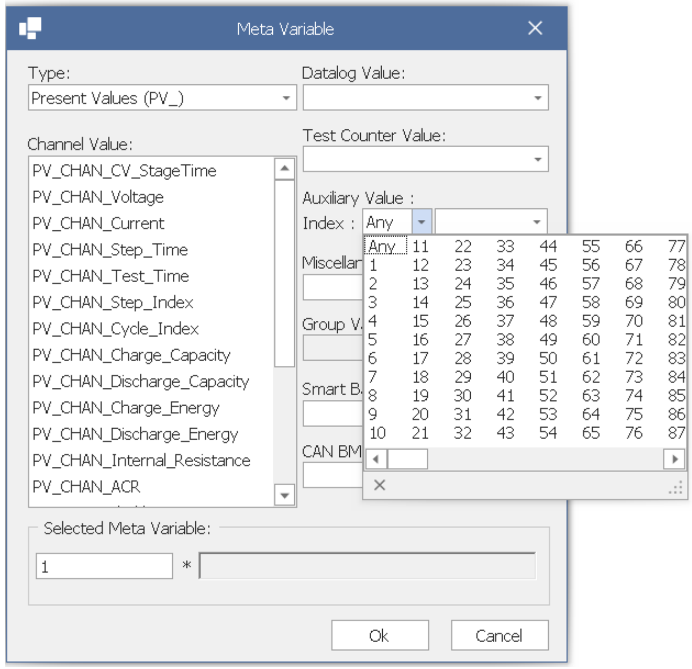


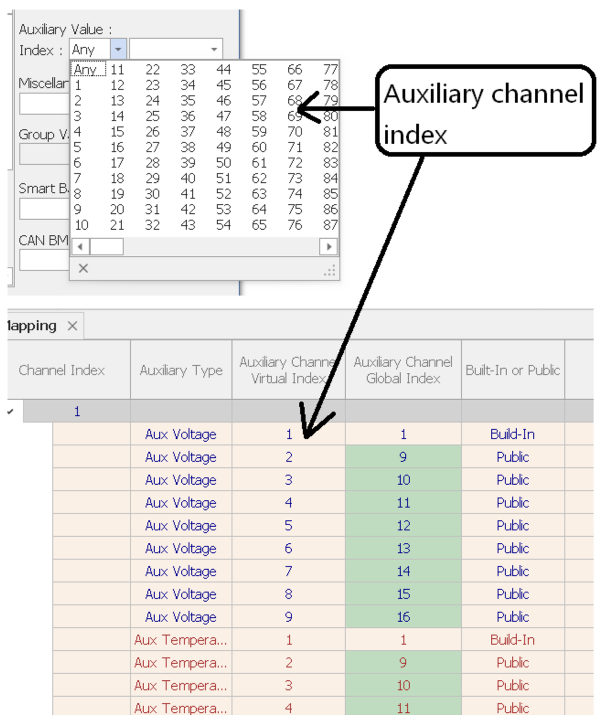
Test Counter-Related Variables

Parameter	Definition
TC_Time1	Timer 1.
TC_Time2	Timer 2.
TC_Time3	Timer 3.
TC_Time4	Timer 4.
TC_Charge_Capacity1	Charge capacity counter 1.
TC_Charge_Capacity2	Charge capacity counter 2.
TC_Discharge_Capacity1	Discharge capacity counter 1.
TC_Discharge_Capacity2	Discharge capacity counter 2.
TC_Charge_Energy1	Charging energy counter 1.
TC_Charge_Energy2	Charging energy counter 2.
TC_Discharge_Energy1	Discharge energy counter 1.
TC_Discharge_Energy2	Discharge energy counter 2.
TC_Counter1	General counter 1.
TC_Counter2	General counter 2.
TC_Counter3	General counter 3.
TC_Counter4	General counter 4.
TC_Counter5	General counter 5.
TC_Counter6	General counter 6.
TC_Counter7	General counter 7.
TC_Counter8	General counter 8.

4: Auxiliary Measurement Variables

Auxiliary measurements include secondary voltage, temperature, and pressure. The relationship between the auxiliary measurement channel and the regular channel can be established in the Mapping page of Mapping Files. Since multiple auxiliary measurement channels can be assigned to a single regular channel, the user needs to select the Auxiliary Channel Virtual Index in the Index box. In the case of assigning multiple auxiliary channels to a regular channel, the index selection can be one of them: Any, 1, 2, ...





One of the channel ordinal choices for the secondary voltage is "Any." When multiple secondary voltages are allocated to a main channel, these secondary voltage channels form a group. When the number of virtual channels is selected as "arbitrary" in a specific step condition (step limit), when any secondary voltage channel in the group reaches this condition, this step condition will take effect.

Auxiliary Channel Measurement-Related Parameters

Parameter	Definition
AV_V	The secondary voltage value measured in volts.
AV_dV/dt	Secondary voltage charge rate. See note 1.
AV_T	Temperature value measured in °C.
AV_dT/dt	Temperature change rate. See note 2.
AV_P	The pressure amount measured in psi.
AV_dP/dt	Pressure change rate. See note 3.
AV_DI	Current digital input channel value (1 (open), 0 (close)).
AV_DO	Current digital output channel value (1 (open), 0 (close)).
AV_Ext_I	External charging current value measured in Amperes.
AV_Humidity	Humidity value measured in %.

NOTE 1: AV_dV/dt = (current AV_V – buffered AV_V)/dt.

- AV_dV/dt is the first-order rage of change of the secondary voltage.
- Current AV_V is the current voltage value.
- Buffer AV_V is the last voltage value in the buffer.
- dt is the time interval between two measurement points.

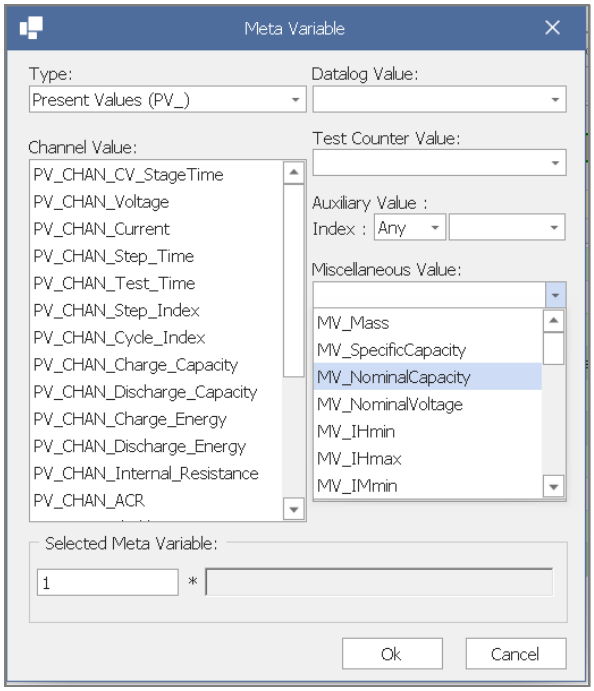
NOTE 2: AV_dT/dt = (current AV_T-buffered AV_T)/dt.

- AV_dT/dt is the first-order rage of change of temperature.
- Current AV_T is the current temperature value.
- Buffer AV_T is the last temperature value in the buffer.
- dt is the time interval between two measurement points.

NOTE 3: AV_dP/dt = (current AV_P-buffered AV_P)/dt.

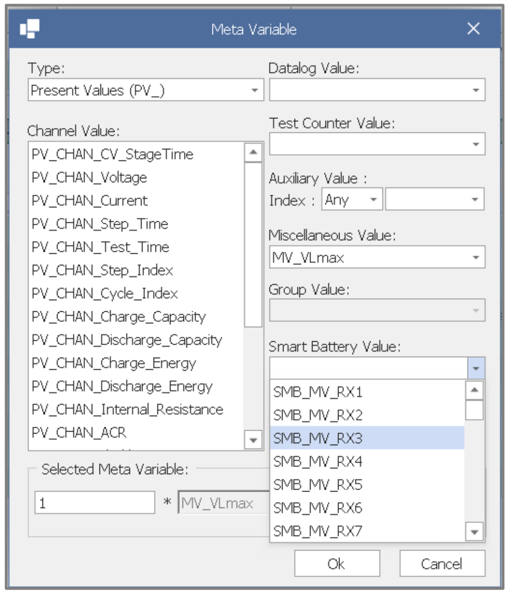
- AV_dP/dt is the first-order rage of change of auxiliary pressure.
- Current AV_P is the current pressure value.
- Buffer AV_P is the last pressure value in the buffer.
- dt is the time interval between two measurement points.

5: Multiple Numerical Variables



Parameter	Definition
MV_Mass	The amount of material set in the Test Object File.
MV_NominalCapacity	Nominal capacity set in the Test Object File.
MV_NominalVoltage	Nominal voltage set in the Test Object File.
MV_IHmin	The minimum value of the high current range.
MV_IHmax	The maximum value of the high current range.
MV_IMmin	The minimum value of the medium current range.
MV_IMmax	The maximum value of the medium current range.
MV_ILmin	The minimum value of the low current range.
MV_ILmax	The maximum value of the low current range.
MV_VHmin	The minimum value of the high voltage range.
MV_VHmax	The maximum value of the high voltage range.
MV_VLmin	The minimum value of the low voltage range.
MV_VLmax	The maximum value of the low voltage range.
MV_UD	Customer-defined variable value.

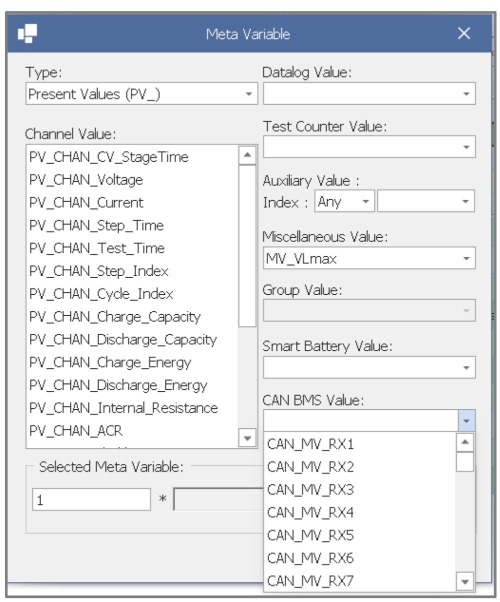
6: Smart Battery Variables



Smart Battery-Related Parameters

Parameter	Definition
SMB_MV	Smart battery variable.

7: CAN BMS Variable



CAN Related Parameters

Parameter	Definition
CAN_MV	CAN channel.

Appendix C: Result Data Units

General Data	Unit	Description
Data_Point		Data point number.
Data_Time		Date and time, in the form of hh:mm:sss.sss in Excel.
Test_Time	Second	Test time for collecting data points; test start time = 0.
Step_Time	Second	Step time to collect data points; step start time = 0.
Cycle_Index		The number of cycles of the current step of the data point.
Step_Index		The number of steps for this data point.
Current	Ampere (A)	The current value of the data point.
Voltage	Volt (V)	The voltage value of the data point.
Charge_Capacity	Ah	The charging capacity of the data point (always a positive number).
Discharge_Capacity	Ah	The discharge capacity of the data point (always a positive number).
Charge_Energy	Watt hour (Wh)	The charging energy for the data point (always a positive number).
Discharge_Energy	Watt hour (Wh)	The discharge energy for the data point (always a positive number).
dV/dt	Volt/sec (V/S)	Voltage vs. time differential.
dV/dQ	Volt/Ah (V/Ah)	Voltage vs. capacity differential.
Internal_Resistance	Ohm	Internal resistance.
Aux_Voltage1*	Volt (V)	The value of the second voltage 1 at the data point.
dAux_Voltage1/dt*	Volt/sec (V/S)	Secondary voltage 1 to time differential.
Temperature1*	°C	The value of temperature 1 at the data point.
dTemperature1/dt*	°C/sec	Temperature 1 to time differential.
Pressure*	Psi	Pressure value of the data point.
Concentration1*	Ppm	The value of concentration 1 at the data point.
DI1*		The value of digital input 1 for the data point.
DO1*		The value of digital output 1 for the data point.
AO		Analog output for the data point.
External Charge	Ampere (A)	Charging current value outside the data point.

Humidity	Percentage (%)	Humidity of the data point.
CAN_RX1		CAN BMS variable 1.
CAN_RX2		CAN BMS variable 2.
CAN_RXn		CAN BMS variable n.
SMB_RX1		Smart battery variable 1.
SMB_RX2		Smart battery variable 2.
SMB_RXn		Smart battery variable n.

General Data	Unit	Description
Charge_Time	Second	The charging time of the cycle (always a positive number).
Discharge_Time	Second	The discharge time of the cycle (always a positive number).
Vmax_On_Cycle	Volt (V)	The highest voltage value in the cycle.
Coulombic_Efficiency	Percentage (%)	Coulomb efficiency for this period (always a positive number).

General Data	Unit	Description
Product_ID		AC impedance mode (1=Gamry, 2=AutoLab, 3=ArbinACIR, 4=ArbinACIM).
Test_ID		Test label.
Channel_ID		Channel label.
Cycle_Index		Cycle label.
Step_Index		Step label.
PT		Data point number, starting from 0. In an AC impedance test step, one frequency corresponds to one Pt.
Freq	Hz	AC signal frequency.
Zmod	Ohm	AC impedance coefficient.
Zphz	Degree	AC impedance phase angle.

Smart Battery Information

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1				SMB REPORT																			
2																							
3				6/14/2021																			
4	Channel	Creator	Comments	Config File Name	BaudRate	Frame Typ	Cell Numb	SMB Unsa	Signal Ena	Signal Log Count													
5	1			Battery.SMB	100K	Extended	0	0	46	46													
6																							
7																							
8	1																						
9	Ieta Variable Nam	SMBRegisterName	SMB Message ID	SMBWriteAddress	SMBReadAddress	SMBByteL	SMBRefre	StartByteI	StartBitIn	EndByteIn	EndBitInd	ByteOrder	MinValue	MaxValue	Offset	ScaleFacto	Enable	DataLog	PEC	DataType	Unit	Display_In_Hex	
10	SMB_MV_RX1	ManfacturerAcce	0x16	0x00	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned		TRUE	
11	SMB_MV_RX2	RemainingCapaci	0x16	0x01	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	mAh	FALSE	
12	SMB_MV_RX3	RemainingTimeA	0x16	0x02	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
13	SMB_MV_RX4	BatteryMode	0x16	0x03	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned		TRUE	
14	SMB_MV_RX5	AtRate	0x16	0x04	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	mA	FALSE	
15	SMB_MV_RX6	AtRateToFull	0x16	0x05	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
16	SMB_MV_RX7	AtRateToEmpty	0x16	0x06	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
17	SMB_MV_RX8	AtRateOK	0x16	0x07	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned		FALSE	
18	SMB_MV_RX9	Temperature	0x16	0x08	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-01	TRUE	TRUE	FALSE	Float	K	FALSE	
19	SMB_MV_RX10	Volatge	0x16	0x09	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-03	TRUE	TRUE	FALSE	Float	V	FALSE	
20	SMB_MV_RX11	Current	0x16	0x0a	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-03	TRUE	TRUE	FALSE	Float	A	FALSE	
21	SMB_MV_RX12	AverageCurrent	0x16	0x0b	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-03	TRUE	TRUE	FALSE	Float	A	FALSE	
22	SMB_MV_RX13	MaxError	0x16	0x0c	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	%	FALSE	
23	SMB_MV_RX14	RelativeStateOfC	0x16	0x0d	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	%	FALSE	
24	SMB_MV_RX15	AbsoluteStateOf(	0x16	0x0e	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	%	FALSE	
25	SMB_MV_RX16	RemainingCpacity	0x16	0x0f	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	mAh	FALSE	
26	SMB_MV_RX17	FullChargeCapaci	0x16	0x10	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	mAh	FALSE	
27	SMB_MV_RX18	RunTimeToEmpty	0x16	0x11	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
28	SMB_MV_RX19	AverageTimeToE	0x16	0x12	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
29	SMB_MV_RX20	AverageTimeToF	0x16	0x13	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned	min	FALSE	
30	SMB_MV_RX21	ChargingCurrent	0x16	0x14	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-03	TRUE	TRUE	FALSE	Float	A	FALSE	
31	SMB_MV_RX22	ChargingVoltage	0x16	0x15	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E-03	TRUE	TRUE	FALSE	Float	V	FALSE	
32	SMB_MV_RX23	BatteryStatus	0x16	0x16	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned		TRUE	
33	SMB_MV_RX24	CycleCount	0x16	0x17	0x16	16	0.00E+00	0	0	1	7	Little Endi	0	65535	0	1.00E+00	TRUE	TRUE	FALSE	Unsigned		FALSE	

Smart Battery Data

1	Date_Time	ManfacturerAcce	Date_Time	Test_Time	Step_Time	Cycle_Ind	Step_Ind	RemainingCapacityAlarm(mA	Date_Time	Test_Time	Step_Time	Cycle_Ind	Step_Ind	RemainingTimeAlarm(mi
2061	06/11/2021 01:42:54.968	0x1A8	06/11/2021 01:42:54.968	11150.8244	724.9999	2	4	600	06/11/2021 01:42:54.968	11150.8244	724.9999	2	4	10
2062	06/11/2021 01:42:59.968	0x1A8	06/11/2021 01:42:59.968	11155.8245	730	2	4	600	06/11/2021 01:42:59.968	11155.8245	730	2	4	10
2063	06/11/2021 01:43:04.969	0x1A8	06/11/2021 01:43:04.969	11160.8248	735.0003	2	4	600	06/11/2021 01:43:04.969	11160.8248	735.0003	2	4	10
2064	06/11/2021 01:43:09.968	0x1A8	06/11/2021 01:43:09.968	11165.8244	739.9999	2	4	600	06/11/2021 01:43:09.968	11165.8244	739.9999	2	4	10
2065	06/11/2021 01:43:14.968	0x1A8	06/11/2021 01:43:14.968	11170.8244	744.9999	2	4	600	06/11/2021 01:43:14.968	11170.8244	744.9999	2	4	10
2066	06/11/2021 01:43:19.968	0x1A8	06/11/2021 01:43:19.968	11175.8245	750	2	4	600	06/11/2021 01:43:19.968	11175.8245	750	2	4	10
2067	06/11/2021 01:43:24.968	0x1A8	06/11/2021 01:43:24.968	11180.8246	755.0001	2	4	600	06/11/2021 01:43:24.968	11180.8246	755.0001	2	4	10
2068	06/11/2021 01:43:29.968	0x1A8	06/11/2021 01:43:29.968	11185.8244	759.9999	2	4	600	06/11/2021 01:43:29.968	11185.8244	759.9999	2	4	10
2069	06/11/2021 01:43:34.968	0x1A8	06/11/2021 01:43:34.968	11190.8246	765.0001	2	4	600	06/11/2021 01:43:34.968	11190.8246	765.0001	2	4	10
2070	06/11/2021 01:43:39.968	0x1A8	06/11/2021 01:43:39.968	11195.8245	770	2	4	600	06/11/2021 01:43:39.968	11195.8245	770	2	4	10
2071	06/11/2021 01:43:44.968	0x1A8	06/11/2021 01:43:44.968	11200.8245	775	2	4	600	06/11/2021 01:43:44.968	11200.8245	775	2	4	10
2072	06/11/2021 01:43:49.968	0x1A8	06/11/2021 01:43:49.968	11205.8244	779.9999	2	4	600	06/11/2021 01:43:49.968	11205.8244	779.9999	2	4	10
2073	06/11/2021 01:43:54.968	0x1A8	06/11/2021 01:43:54.968	11210.8246	785.0001	2	4	600	06/11/2021 01:43:54.968	11210.8246	785.0001	2	4	10
2074	06/11/2021 01:43:59.969	0x1A8	06/11/2021 01:43:59.969	11215.8247	790.0002	2	4	600	06/11/2021 01:43:59.969	11215.8247	790.0002	2	4	10
2075	06/11/2021 01:44:04.968	0x1A8	06/11/2021 01:44:04.968	11220.8244	794.9999	2	4	600	06/11/2021 01:44:04.968	11220.8244	794.9999	2	4	10
2076	06/11/2021 01:44:09.969	0x1A8	06/11/2021 01:44:09.969	11225.8247	800.0002	2	4	600	06/11/2021 01:44:09.969	11225.8247	800.0002	2	4	10
2077	06/11/2021 01:44:14.969	0x1A8	06/11/2021 01:44:14.969	11230.8247	805.0002	2	4	600	06/11/2021 01:44:14.969	11230.8247	805.0002	2	4	10
2078	06/11/2021 01:44:19.968	0x1A8	06/11/2021 01:44:19.968	11235.8244	809.9999	2	4	600	06/11/2021 01:44:19.968	11235.8244	809.9999	2	4	10
2079	06/11/2021 01:44:24.969	0x1A8	06/11/2021 01:44:24.969	11240.8247	815.0002	2	4	600	06/11/2021 01:44:24.969	11240.8247	815.0002	2	4	10
2080	06/11/2021 01:44:29.968	0x1A8	06/11/2021 01:44:29.968	11245.8244	819.9999	2	4	600	06/11/2021 01:44:29.968	11245.8244	819.9999	2	4	10
2081	06/11/2021 01:44:34.968	0x1A8	06/11/2021 01:44:34.968	11250.8244	824.9999	2	4	600	06/11/2021 01:44:34.968	11250.8244	824.9999	2	4	10
2082	06/11/2021 01:44:39.968	0x1A8	06/11/2021 01:44:39.968	11255.8244	829.9999	2	4	600	06/11/2021 01:44:39.968	11255.8244	829.9999	2	4	10
2083	06/11/2021 01:44:44.968	0x1A8	06/11/2021 01:44:44.968	11260.8245	835	2	4	600	06/11/2021 01:44:44.968	11260.8245	835	2	4	10
2084	06/11/2021 01:44:49.968	0x1A8	06/11/2021 01:44:49.968	11265.8246	840.0001	2	4	600	06/11/2021 01:44:49.968	11265.8246	840.0001	2	4	10
2085	06/11/2021 01:44:54.969	0x1A8	06/11/2021 01:44:54.969	11270.8247	845.0002	2	4	600	06/11/2021 01:44:54.969	11270.8247	845.0002	2	4	10

CAN BMS Information Data

			CAN REPORT		
			2021/6/18		
Creator	Comments	Config File Name	Frame Type	Signal Enable Count	Signal Log Count
		normal_CANConfig.c	Extended	50	50

CANPort	IsCANFD	CANBaudRate	CANFDBitRate	CANUnsafeTimeout
1	FALSE	500K	Default	5000ms
2	FALSE	500K	Default	5000ms
3	TRUE	500K	Default	5000ms
4	TRUE	500K	Default	5000ms
5	TRUE	500K	Default	5000ms

CANPort	/leta Variable Nam	Nick Name	CAN Message ID	DLC of CAN Message	Byte Order	DataType	Start Byte Index	Start Bit Index	End Byte Index	End Bit Index	Value Offset	Value Scale Eactor	Enable	Data Log	Unit
1	CAN_MV_RX1	0_l	0x1	8	Little Endian	Unsigned	0	0	0	7	0	1	YES	YES	
1	CAN_MV_RX2	1_l	0x1	8	Little Endian	Unsigned	1	0	1	7	0	0.5	YES	YES	A
1	CAN_MV_RX3	2_l	0x1	8	Little Endian	Unsigned	2	0	2	7	0	1	YES	YES	V
1	CAN_MV_RX4	3_l	0x1	8	Little Endian	Unsigned	3	0	3	7	0	1	YES	YES	
1	CAN_MV_RX5	4_l	0x1	8	Little Endian	Unsigned	4	0	4	7	0	1	YES	YES	
1	CAN_MV_RX6	5_l	0x1	8	Little Endian	Unsigned	5	0	5	7	0	1	YES	YES	
1	CAN_MV_RX7	6_l	0x1	8	Little Endian	Unsigned	6	0	6	7	0	1	YES	YES	
1	CAN_MV_RX8	7_l	0x1	8	Little Endian	Unsigned	7	0	7	7	0	1	YES	YES	
1	CAN_MV_RX9	0_b	0x1	8	Big Endian	Unsigned	0	0	0	7	0	1	YES	YES	
1	CAN_MV_RX10	1_b	0x1	8	Big Endian	Unsigned	1	0	1	7	0	1	YES	YES	
1	CAN_MV_RX11	2_b	0x1	8	Big Endian	Unsigned	2	0	2	7	0	1	YES	YES	
1	CAN_MV_RX12	3_b	0x1	8	Big Endian	Unsigned	3	0	3	7	0	1	YES	YES	
1	CAN_MV_RX13	4_b	0x1	8	Big Endian	Unsigned	4	0	4	7	0	1	YES	YES	
1	CAN_MV_RX14	5_b	0x1	8	Big Endian	Unsigned	5	0	5	7	0	1	YES	YES	
1	CAN_MV_RX15	6_b	0x1	8	Big Endian	Unsigned	6	0	6	7	0	1	YES	YES	
1	CAN_MV_RX16	7_b	0x1	8	Big Endian	Unsigned	7	0	7	7	0	1	YES	YES	
1	CAN_MV_RX17	10_l	0x2	8	Little Endian	Unsigned	0	0	1	7	0	1	YES	YES	
1	CAN_MV_RX18	11_l	0x2	8	Little Endian	Unsigned	2	0	3	7	0	1	YES	YES	
1	CAN_MV_RX19	12_l	0x2	8	Little Endian	Unsigned	4	0	5	7	0	1	YES	YES	
1	CAN_MV_RX20	13_l	0x2	8	Little Endian	Unsigned	6	0	7	7	0	1	YES	YES	
1	CAN_MV_RX21	10_b	0x3	8	Big Endian	Unsigned	1	0	0	7	0	1	YES	YES	

CAN BMS Data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
Date_Time	Test_Time(s)	Step_Time(s)	Cycle_Index	Step_Index	0_l	1_l	2_l	3_l	4_l	5_l	6_l	7_l	0_b	1_b	2_b	3_b	4_b	5_b	6_b	7_b	10_l	11_l	12_l	13_l	10_b	11_b
06/18/2021 12:30:12.795	1.0006	1.0006	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06/18/2021 12:30:13.795	2.0003	2.0003	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	0	0	0	0	0
06/18/2021 12:30:14.795	3.0006	3.0006	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	0	0
06/18/2021 12:30:15.795	4.0003	4.0003	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:16.795	5.0006	5.0006	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:17.795	6.0003	6.0003	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:18.795	7.0006	7.0006	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:19.795	8.0007	8.0007	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:20.795	9.0003	9.0003	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:21.795	10.0005	10.0005	1	1	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:22.801	11.0071	1.0005	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:23.801	12.007	2.0004	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:24.801	13.0068	3.0002	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:25.801	14.0068	4.0002	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:26.802	15.0072	5.0006	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:27.802	16.0072	6.0006	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:28.802	17.0073	7.0007	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:29.801	18.0068	8.0002	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:30.802	19.0072	9.0006	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:31.801	20.0068	10.0002	1	2	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:32.807	21.0131	1.0003	1	3	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11
06/18/2021 12:30:33.808	22.0132	2.0004	1	3	0	0.5	2	3	4	5	6	7	0	1	2	3	4	5	6	7	10	11	12	13	10	11

ACIM Data

Cycle_ID	Step_ID	Pt	Freq	Zmod	Zphz
1	5	20	110	3	89
2	5	20	110	3	89
3	5	20	110	3	89