



BMS Service Tool Manual

Document Number: 3342945

Document Version: 04

CONFIDENTIAL



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1. Introduction

1.1 Purpose

This document describes how to:

- Setting up the Altairnano BMS Service Tool software.
- Configuring single and multi-string battery management systems (BMS).
- Monitoring BMS status and generating log files.

1.2 Scope

This document serves as a comprehensive guide for users of the Altairnano BMS Service Tool.

- It provides detailed instructions on configuring battery strings and monitoring BMS status.
- The guide covers both single-string and multi-string configurations of battery management systems.
- Users will learn how to generate log files in CSV format for analysis and reporting.

1.3 Definitions, Acronyms, and Abbreviations

Term	Definition
BMS	Battery Management System
BMU	Battery Management Unit
CAN	Controller Area Network
CSV	Comma Separated Values
DTC	Diagnostic Trouble Code tracks fault conditions in the battery string for reporting over the CAN bus
JDK	Java Development Kit (for Java software developers)
JRE	Java Runtime Environment (for typical Java software usage)
LMU	Local Monitoring Unit
LRU	Line Replaceable Unit (refers to a battery module or pack)
SOC	State of Charge

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2. BMS Service Tool Installation

2.1 Windows PC with Open USB Port

Altairnano supports the BMS Service Tool with the Windows operating system installed. An open USB port is required to connect the Kvaser CAN communication device to the PC.



2.2 Kvaser CAN Communication Device

The BMS Service Tool is designed to work with the Kvaser Leaf Family or USB Rugged CAN Tools. Kvaser product details and drivers can be found at the Kvaser website <http://www.kvaser.com/>. Drivers for the Kvaser CAN device must be installed onto the PC prior to running the BMS Service Tool software.



2.3 Java Runtime Environment

2.3.1 Oracle Java Software

For the BMS Service Tool to function properly, ensure you have the Oracle Java Runtime Environment (JRE) version 6 or higher installed on your PC. The BMS Service Tool is developed using the Java programming language. Compatible versions include the Windows x86 version 8u241 JRE (for regular Java application users) or the Windows x86 8u241 JDK (for programmers requiring source code compilation). It's noteworthy that while newer Java 8 versions may necessitate a purchased license from Oracle, they remain functional with the BMS Service Tool. For details regarding licensing requirements and usage restrictions, consult Oracle's guidelines. Download Oracle Java from the provided link: [Java Download](#).

Oracle Java can be downloaded at the following location: [Java Download](#)

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2.3.2 OpenJDK Java Software

The Java Runtime Environment version 8 must be installed on the PC. The BMS Service Tool is developed using the Java programming language. The BMS Service Tool is compatible with **version 8 Windows x86 32-bit JRE MSI** (the JRE version is for users of Java applications) or **version 8 Windows x86 32-bit JDK MSI** (the JDK version is for programmers that need to compile source code). Versions newer than version 8 may not function properly due to feature changes in the Java programming language.

NOTE: OpenJDK does not support Java Web Start like Oracle Java, so OpenJDK requires the offline Windows installer version of the BMS Service Tool software.

OpenJDK can be downloaded at one of the following locations:

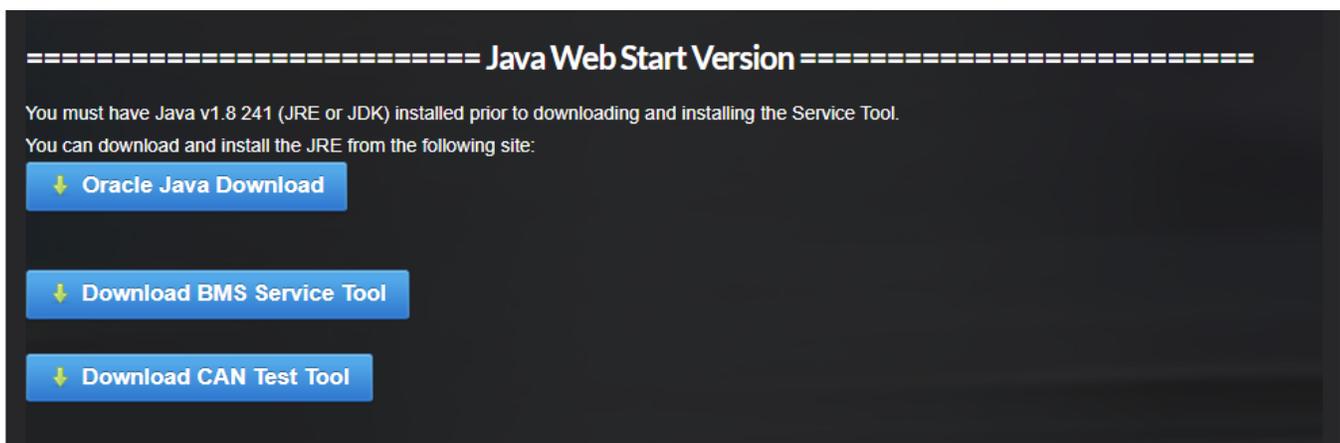
- [Eclipse Temurin OpenJDK Download](#)
- [OpenLogic OpenJDK Download](#)

2.4 BMS Service Tool Installation

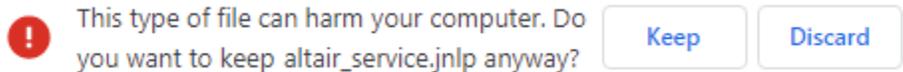
2.4.1 Java Web Start Installation

The BMS Service Tool can be installed from the website https://altairnano.com/service_tool/

Select the ‘Download BMS Service Tool’ button. Make sure to use the button in the “**Java Web Start Version**” section of the website.



Select the ‘Keep’ button.

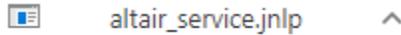




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Select the downloaded .jnlp file.



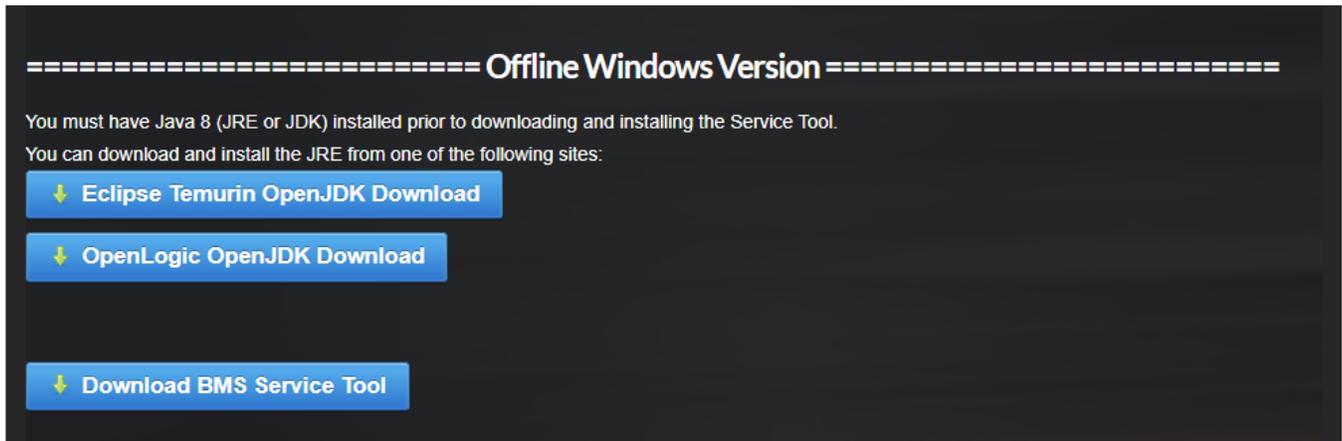
The BMS Service Tool should launch at this time.

2.4.2 Offline Windows Installation

Installing the Offline Windows version does **NOT** require Administrator privilege on the Windows OS. The offline installer of the BMS Service Tool can be downloaded from the website:

https://altairnano.com/service_tool/

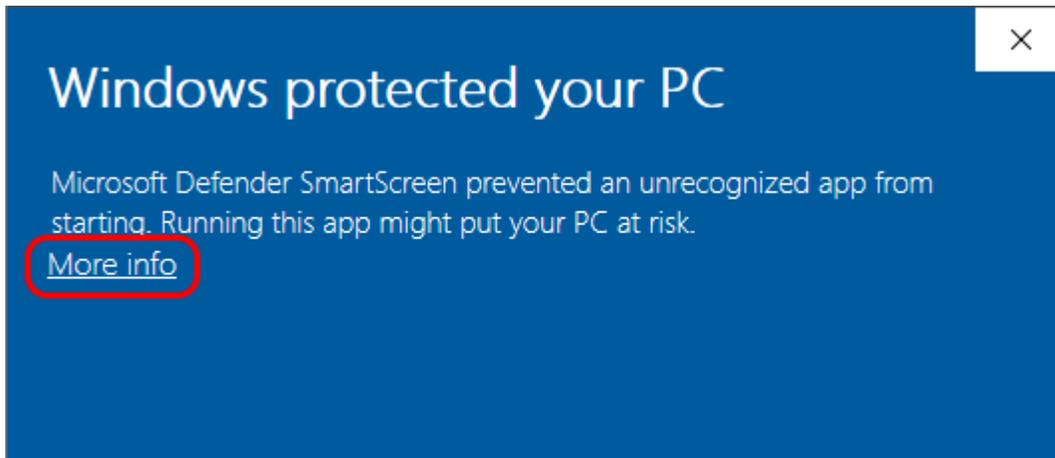
Select the ‘Download BMS Service Tool’ button. Make sure to use the button in the **“Offline Windows Version”** section of the website.



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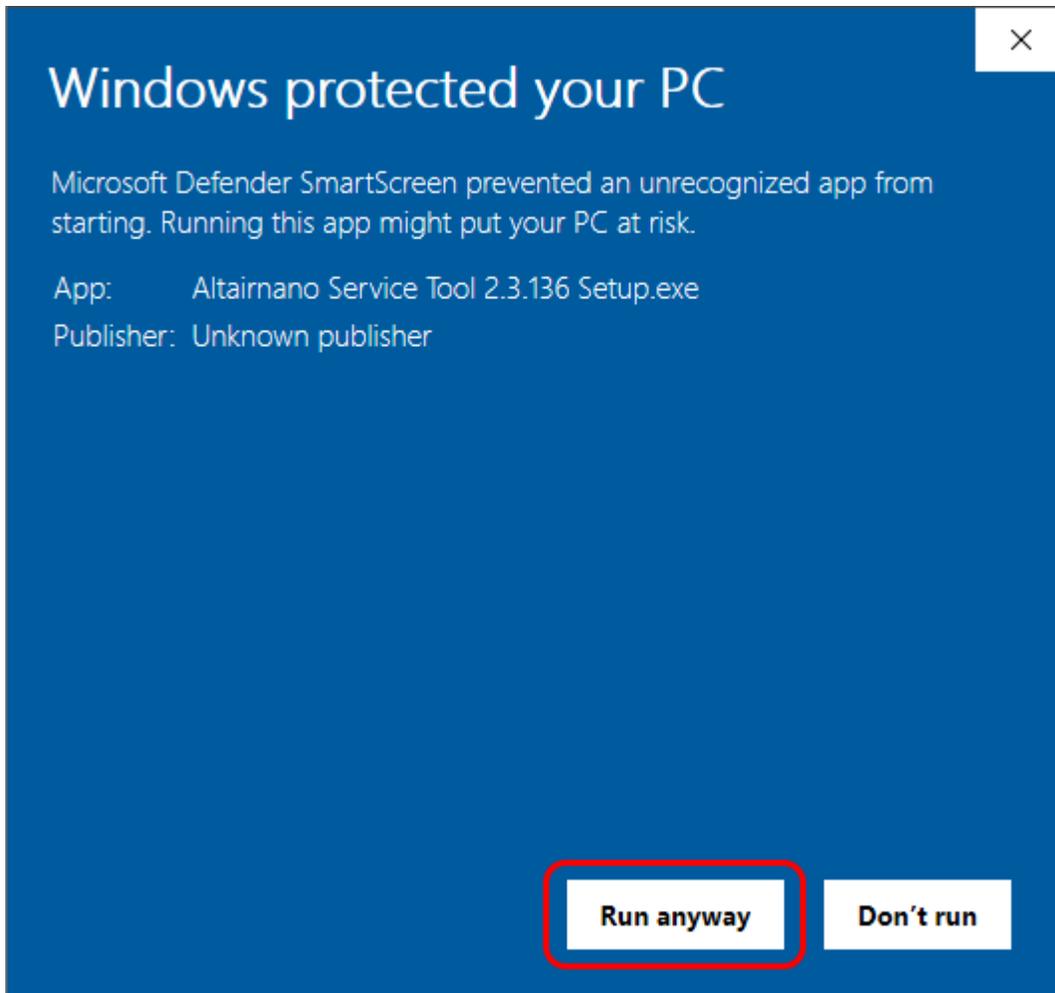
Once the file has finished downloading, double click on the file in Windows Explorer. A dialog box like the image below may appear. If so, **select the 'More info' link.**



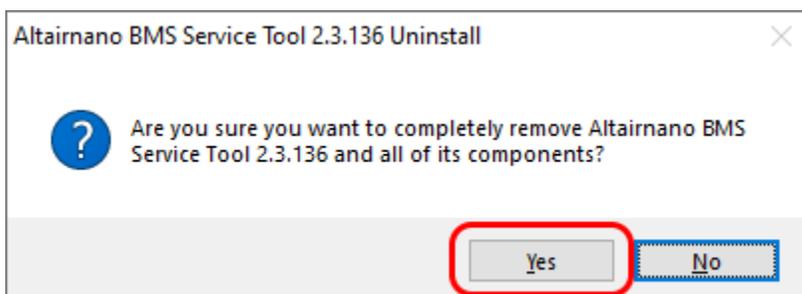
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Select the 'Run anyway' button.



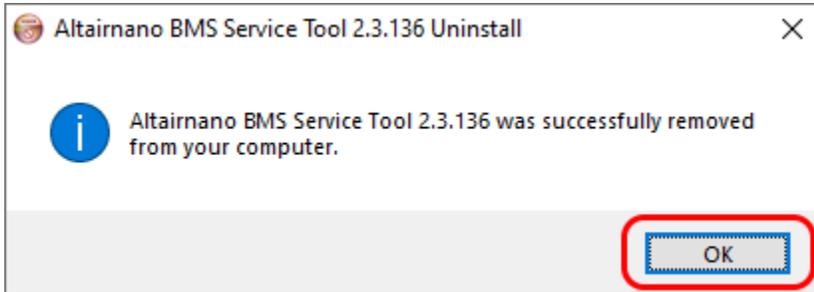
If a previous version of the Service Tool was installed using the Windows installer, the following dialog box will appear. **Select the 'Yes' button to remove the old version.**



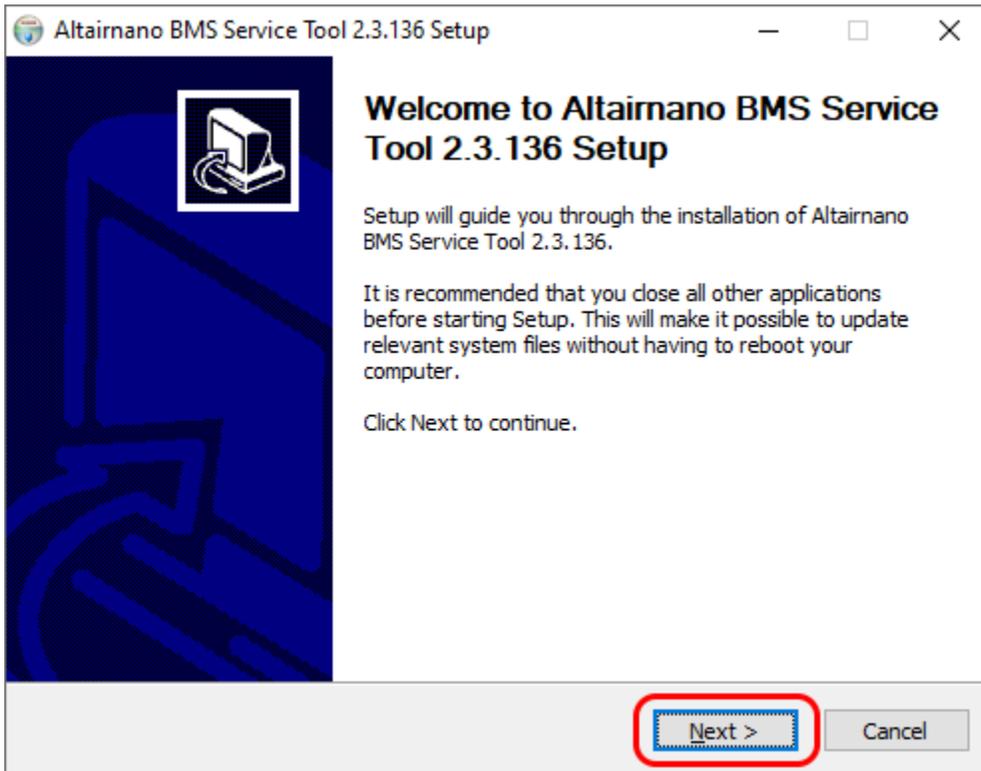
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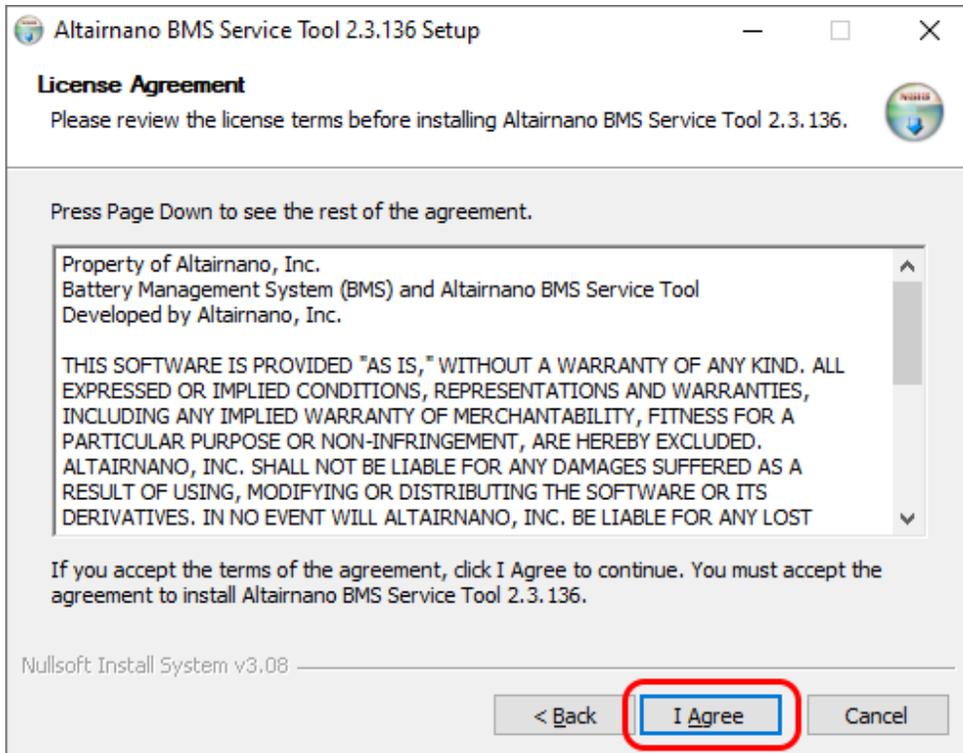
Select the 'OK' button.



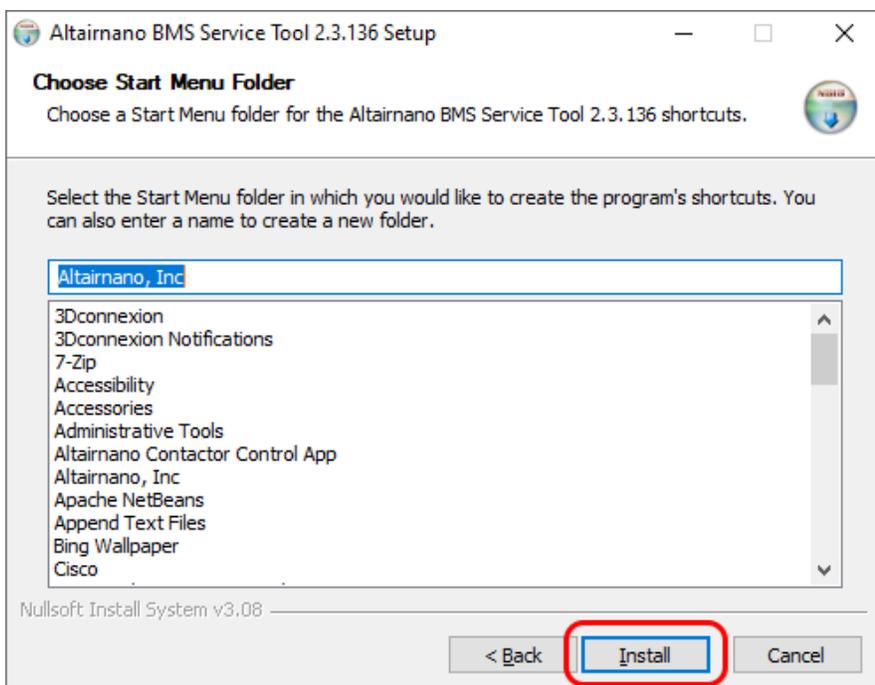
On the Altairnano BMS Service Tool installation dialog panel, select the 'Next' button.



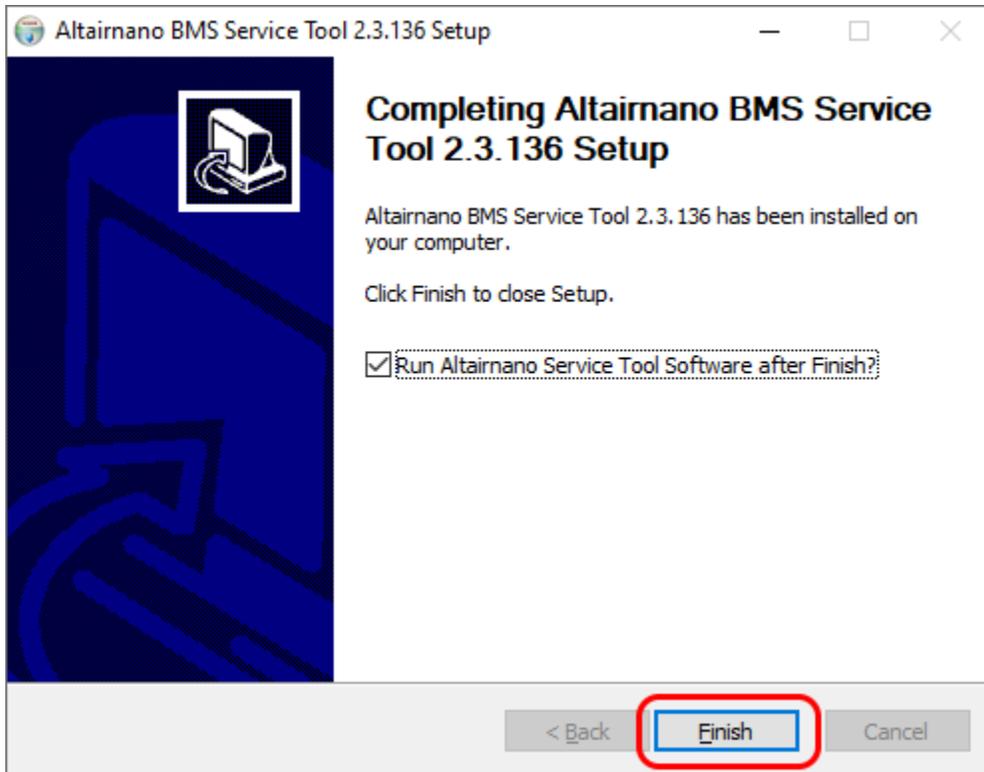
Select the 'I Agree' button.



Select the 'Install' button.



Select the 'Finish' button.



The BMS Service Tool should launch at this time.

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3. First Time Startup of BMS Service Tool

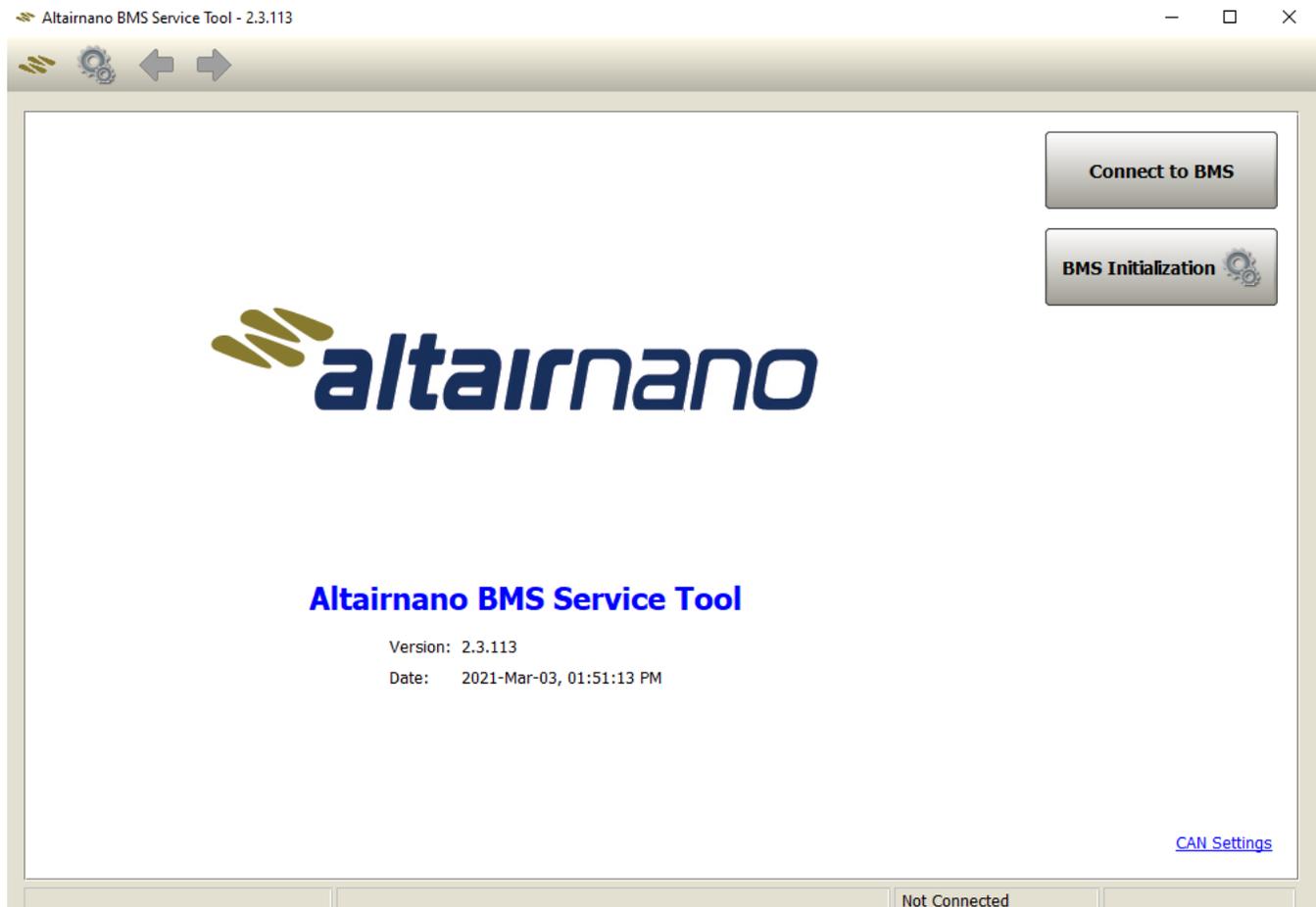
The following sections describe the process for using the BMS Service Tool for the first time, including how to configure a new Altairnano Battery System for use.

3.1 BMS Service Tool Launching

After installation, accessing the BMS Service Tool can be achieved through various methods:

- **Desktop Icon:** Look for the Altairnano BMS Service Tool desktop icon and double-click to launch the software.
- **Start Menu Link:** Navigate to the Start menu, find the Altairnano folder, and click on "Altairnano BMS Service Tool" to launch it.

If using the Java Web Start version, the software will automatically check for updates upon launch. In case of no internet connection, expect a potential delay as the software attempts to connect. For the offline Windows installer version, updates need manual intervention upon new releases.



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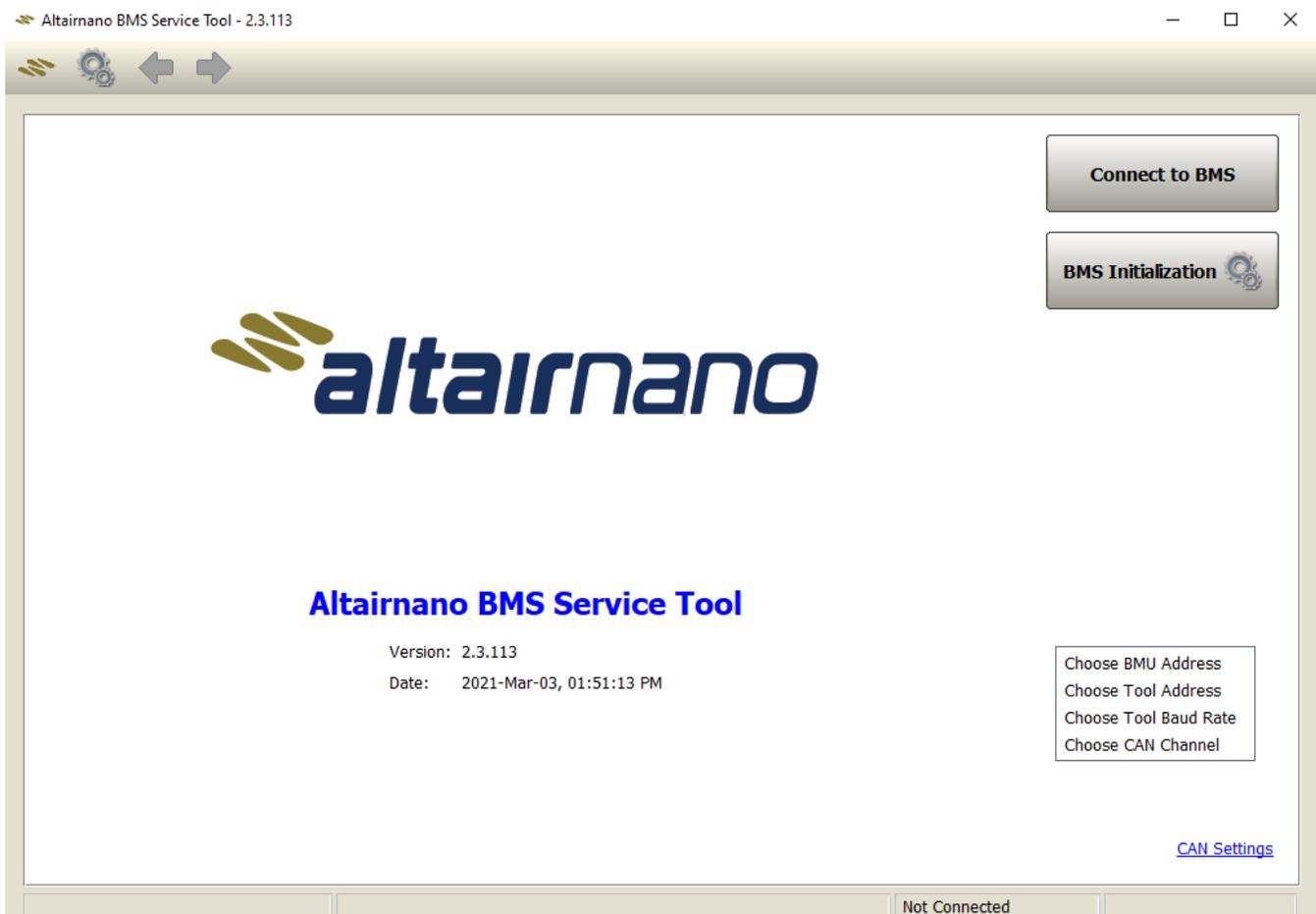
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3.2 BMS Service Tool Settings

Configuring the BMS Service Tool for optimal performance involves navigating through its settings:

- Access the settings menu by selecting "CAN_Settings" or right-clicking on any blank area of the application screen.
- Configure the "BMU Address," which comprises the last two digits of the hexadecimal address (default is 0x03) for CAN communication with the BMU.
- The *Tool Baud Rate* is the CAN bus speed of the BMU (default is BITRATE_250K).

NOTE: If the default settings are not working and the correct settings are not known, see section 6 CAN Test Software to help find the correct settings.

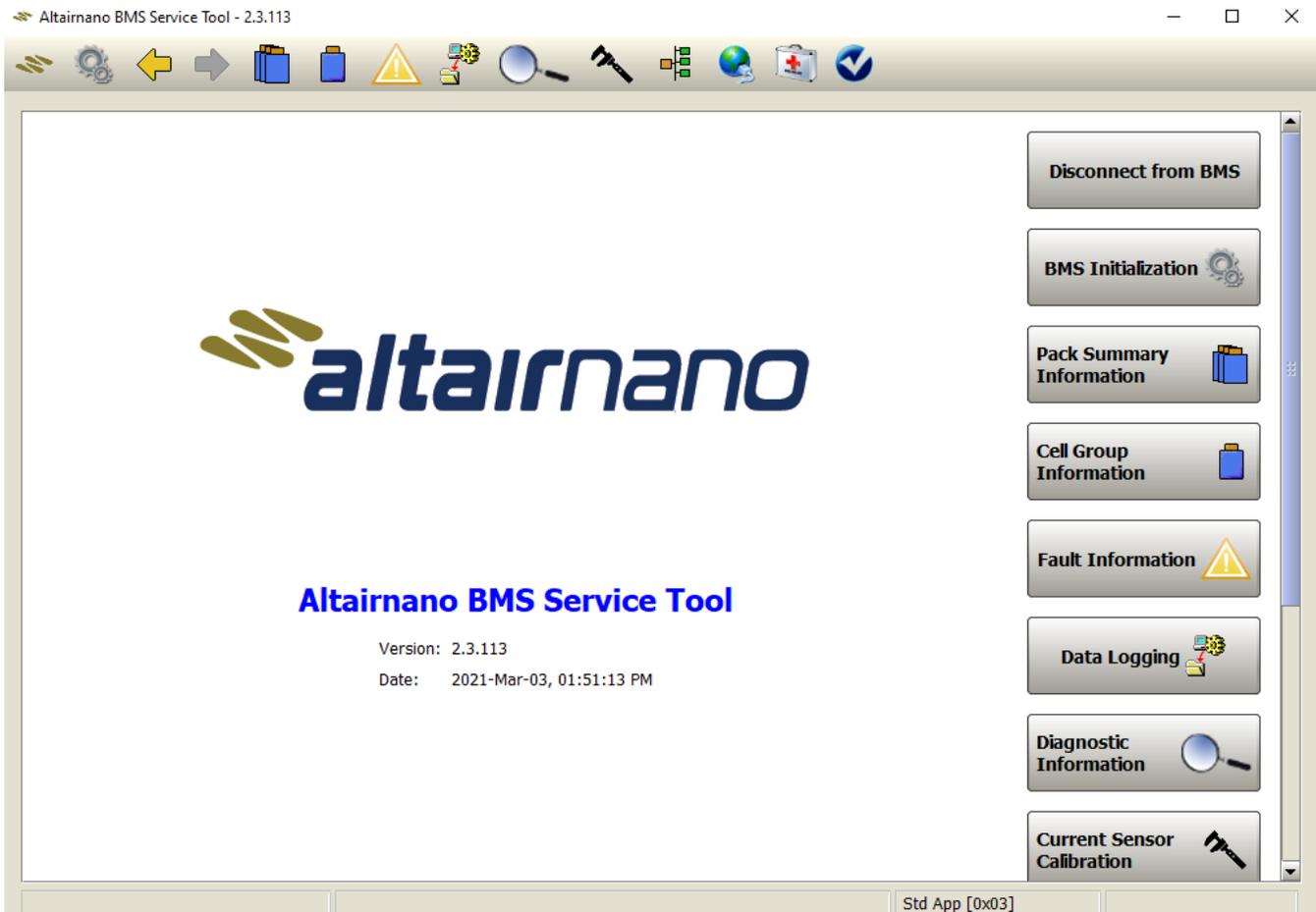


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3.3 BMS Service Tool Connection

Click the ‘Connect to BMS’ button. If the CAN bus connection and CAN settings are correct and the proper drivers are installed the service tool will communicate with the BMU.



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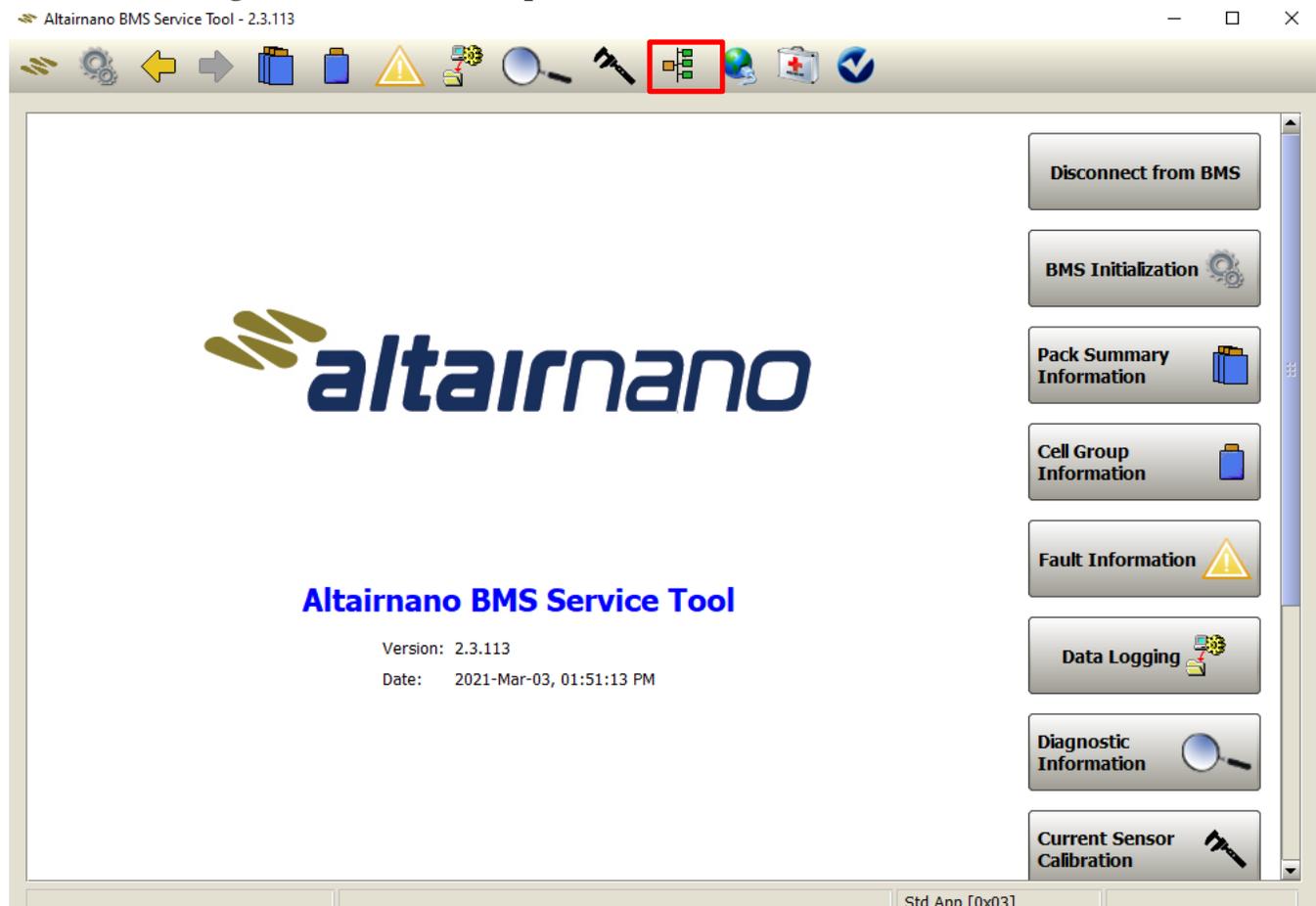
3.4 Configuration & LMU Setup Screen (First Time Startup of BMS)

The BMU software configuration should define the battery cell, temperature and LMU connection details to the BMU. At initial startup, the BMU will not know the LMUs it is connected to or the order in which they are connected to the batteries. The BMU will discover the LMUs communicating on the internal CAN bus but does not know if the communicating LMUs are associated with the battery system the BMU manages. The BMS Service Tool helps configure the BMU to know what LMUs are connected to the battery system and the sort order of the LMUs. The number of LMUs found and configured must match the battery configuration defined in the BMU firmware.

During the initial startup, configuring the BMU's software settings is essential:

- Navigate to the "Configuration & LMU Setup" screen.
- Verify that the LMUs communicating on the internal CAN bus are correctly identified.
- Confirm that the LMU configuration matches the battery configuration defined in the BMU firmware.
- Enable the LMUs to be monitored and save the configuration once complete.

Select the 'Configuration & LMU Setup' button.

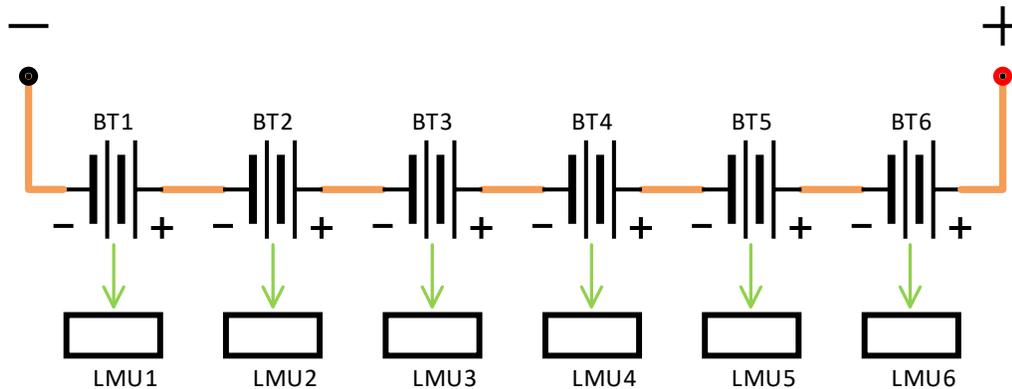


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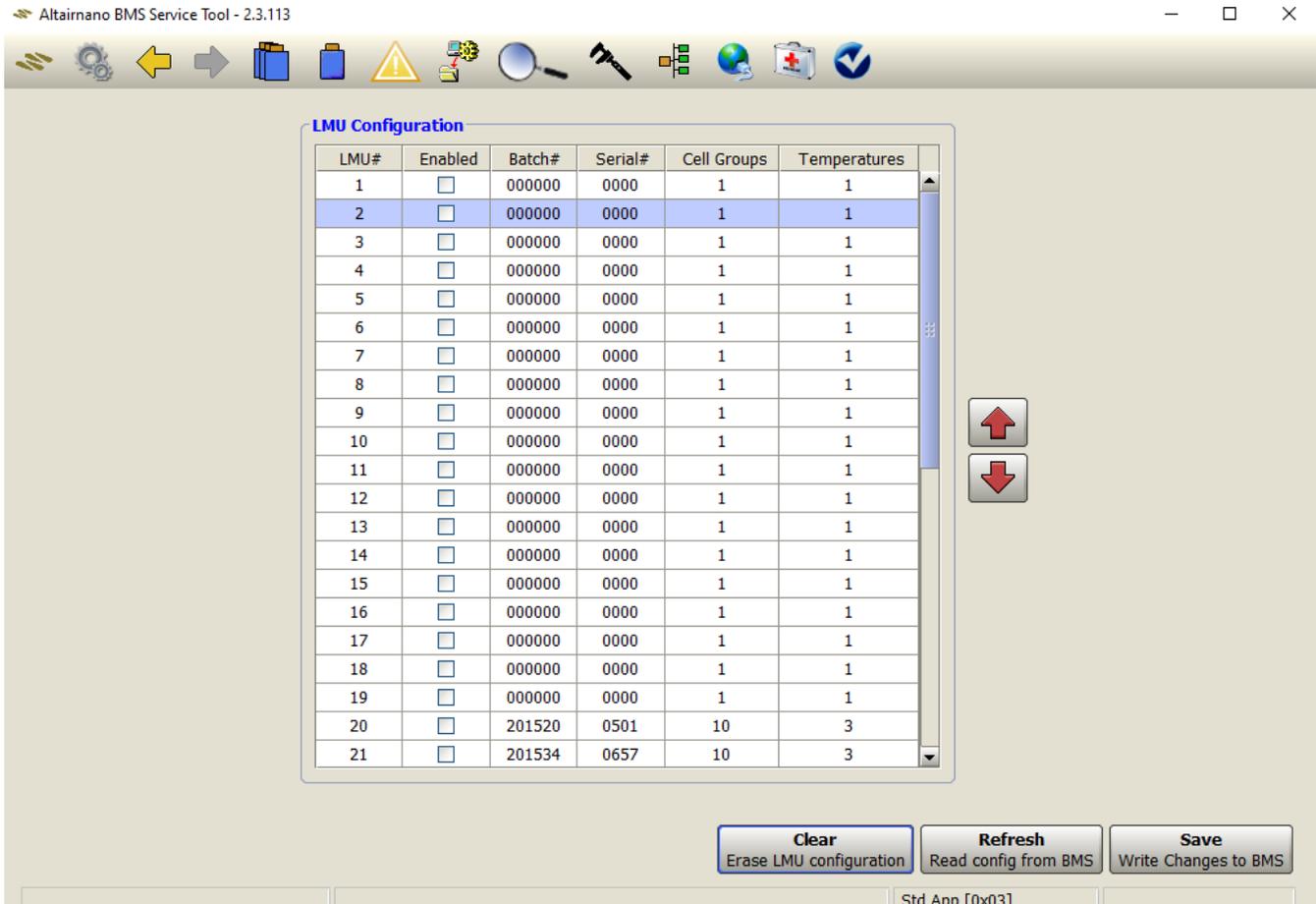
The BMS Service Tool will list the LMUs that are communicating on the internal CAN bus. Verify that the Batch# (6-digit number highlighted in yellow) and Serial# (4-digit number highlighted in pink) match the LMUs' Labels.



The BMU will not know the order that the LMUs are in. LMU# column designates the order that the BMU will sort the LMU information (cell voltage 1, 2, 3, etc.). LMU# 1 is the LMU monitoring the lowest battery module voltage. As the LMU# increases the battery voltage monitored increases in order. See image below for clarification.



The Cell Groups and Temperatures column numbers must match the number of cell groups and temperature sensors monitored by the LMUs. The numbers in the columns should be common for each LMU, but in some rare cases the numbers will be different for each LMU if there is not a consistent ratio of LMUs to battery modules.



After the configuration is set up and the LMUs are in the proper order, the LMUs monitored must be enabled and the configuration must be saved. Mouse click the box in the enabled column to enable the BMU to monitor the discovered LMU. When the configuration is complete, **select the ‘Save’ button.**

The ‘Clear’ button erases the LMU configuration stored in the BMU. This can be useful if a hardware change was made to the BMS.

The ‘Refresh’ button will ask the BMU to resend the information to the BMS Service Tool and update the list.

NOTE: The BMU will only connect to a battery if the BMU configuration and the LMU configuration are compatible. Also, if the BMU receives communication from an LMU it does not recognize, it will not close the battery contactors and will set a fault condition.

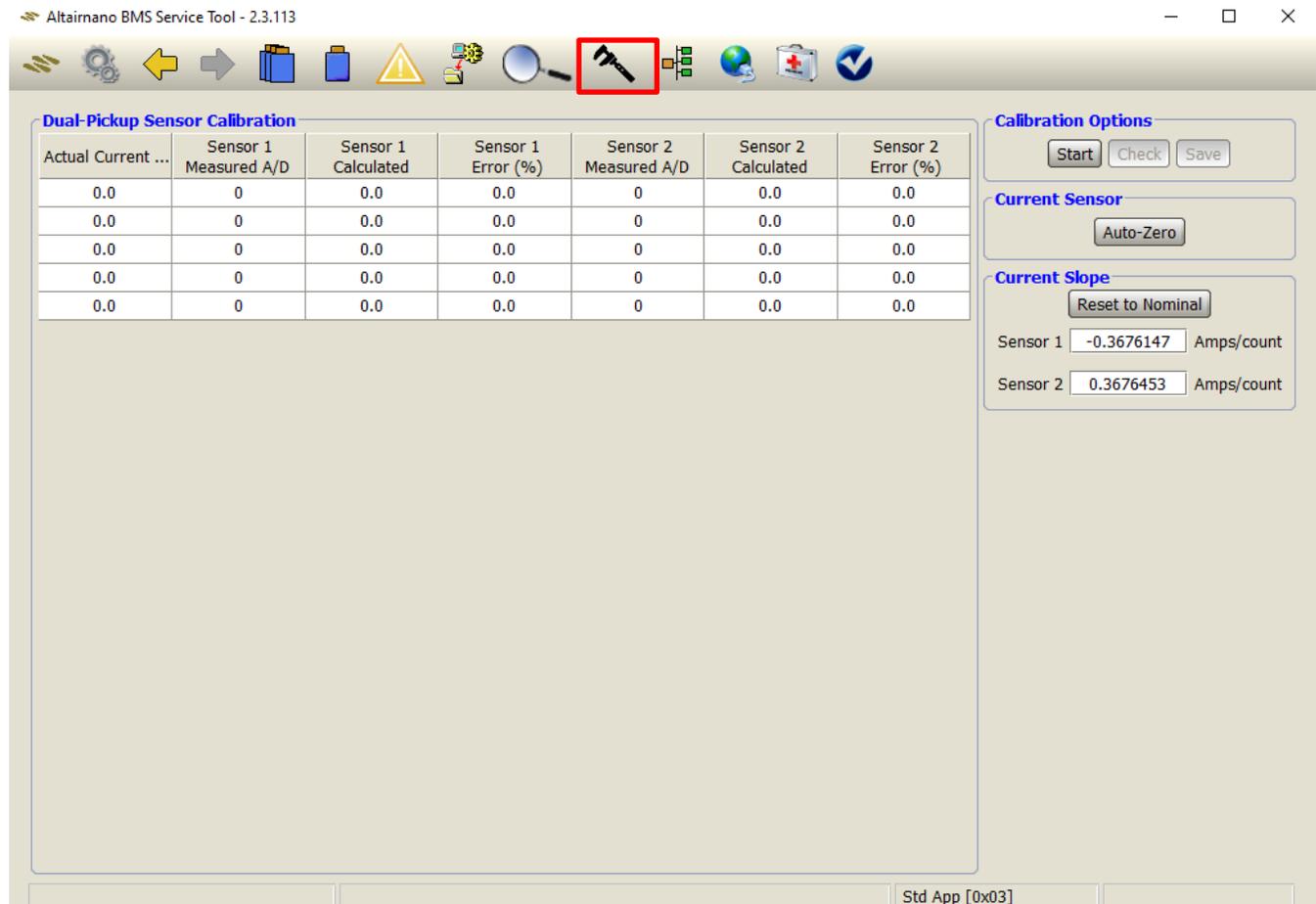
3.5 Current Sensor Calibration Screen (First Time Startup of BMS)

The Current Sensor Calibration screen is used to calibrate the current sensor. The BMS Service Tool prompts to set the charging or discharging currents. This data is used to determine the slope of the current sensors. All Disconnect level fault codes must be cleared for the BMS to connect DC bus.

NOTE: During calibration ‘+’ current is charging the battery string and ‘-’ current is discharging the battery string. The negative sign should be added when typing the value into the dialog box.

- Select the ‘Start’ button in the ‘Calibration Options’ frame to begin calibration.
- Set the charging and discharging currents as prompted.
- Validate the calibration data by clicking the "Check" button.
- Save the calibration settings once validated.

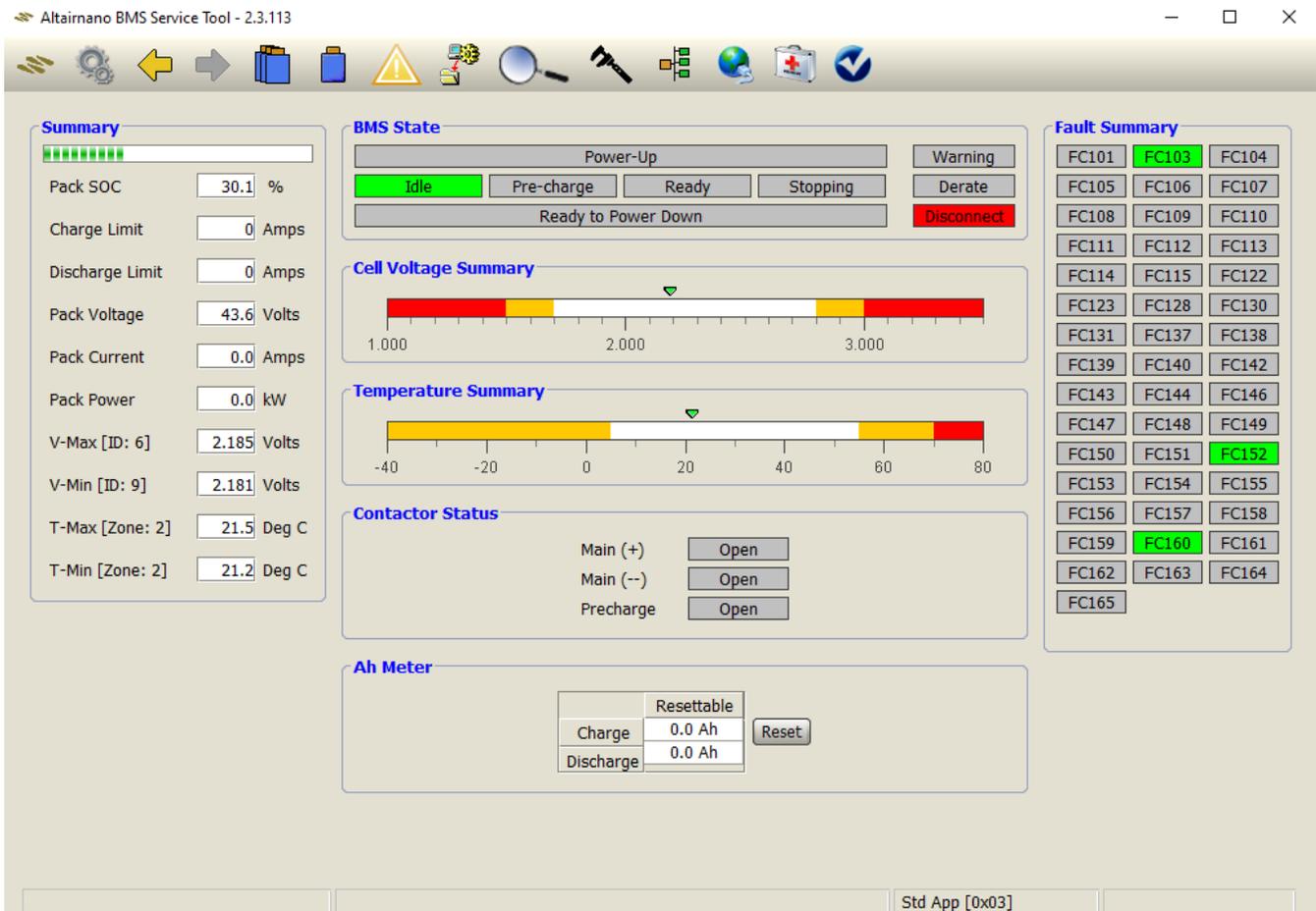
The ‘Current Slope’ frame displays the slope translation that the BMU is currently using to measure current from the current sensor. The Sensor 1 and Sensor 2 values can be manually adjusted, but you must clear the current value, type the new value and **press ‘Enter’ on the keyboard** to save the value. **Select the ‘Reset to Nominal’ button** to change the slope values back to firmware defaults.



4. Service Tool Interface Information

4.1 Pack Summary Information Screen

The Pack Summary Information screen provides the status of the BMS and battery at a glance. The screen summarizes battery information such as battery SOC, voltage, temperature, active conditions, faults, contactor states, and other information. The screen information adapts to the software configured in the BMU; only displaying relevant information. Many of the information fields will display quick summaries by hovering over the field with the mouse cursor. This is most useful with the Fault Summary fields.



4.2 Cell Group Information Screen

The Cell Group Information screen displays a summary for all cell groups monitored by the BMS and their associated temperatures. The BMS Service Tool displays each cell group's information: system level cell group 'ID', 'LMU' number (same number as Configuration & LMU Setup screen), LMU 'Cell Group' number, 'LRU' is the battery module or pack number, 'SOC' (state of charge), 'Volts', 'Temperature' (zoned), and 'Balance' activity (green dot means balance resistor is on). This screen is used to view specific details of a cell group and battery module.

Altairnano BMS Service Tool - 2.3.113

ID	LMU	Cell Group	LRU	SOC	Volts	Temperature	Balance
1	1	1	1	76.0%	2.359 V	23.6°C (Zone 1)	
2	1	2	1	77.9%	2.374 V	34.8°C (Zone 1)	
3	1	3	1	77.8%	2.373 V	23.6°C (Zone 1)	
4	1	4	1	77.8%	2.373 V		
5	1	5	1	77.8%	2.374 V		
6	1	6	1	77.9%	2.374 V		
7	1	7	1	78.0%	2.375 V		
8	1	8	1	78.0%	2.375 V		
9	1	9	1	78.0%	2.375 V		
10	1	10	1	78.1%	2.375 V		

Std App [0x03]

4.3 Fault Information Screen

The Fault Information screen displays detailed information on the DTC's (Diagnostic Trouble Code) of the BMS. If a fault code is selected, a description of the fault will be displayed in the description frame along the bottom of the Fault Information screen.

The BMU keeps track of fault code history. If a fault condition is present a green dot is displayed in the 'State' column. The 'Count' column displays how many times the fault has been active. The 'Parameter' column displays additional details of the fault condition if applicable. The 'Timer' column displays how long the fault has been active. Some fault conditions are latched and must be cleared either with the Application Command message or by the BMS Service Tool. Select the 'Clear Faults + History' button to clear any latched fault conditions. The BMS Service Tool clears the state, count, parameters and timer information; however, the Application Command message only clears the state.

Altairnano BMS Service Tool - 2.3.113

Code	Name	State	Count	Parameter	Timer
FC101	EXTERNAL_ESTOP_FAULT		0		00:00:00
FC103	COMM_TIMEOUT_APP_BUS	●	1		00:06:06
FC104	LMU_NOT_REPORTING		0		00:00:00
FC105	PACK_VOLTAGE_MISMATCH		0		00:00:00
FC106	CELL_TEMPERATURE_ABOVE_NORMAL_RA...		0		00:00:00
FC107	CELL_TEMPERATURE_BELOW_NORMAL_RA...		0		00:00:00
FC108	CELL_TEMPERATURE_FAR_ABOVE_NORMA...		0		00:00:00
FC109	CELL_TEMPERATURE_FAR_BELOW_NORMA...		0		00:00:00
FC110	CELL_VOLTAGE_ABOVE_NORMAL_RANGE		0		00:00:00
FC111	CELL_VOLTAGE_BELOW_NORMAL_RANGE		0		00:00:00
FC112	CELL_VOLTAGE_FAR_ABOVE_NORMAL_RA...		0		00:00:00
FC113	CELL_VOLTAGE_FAR_BELOW_NORMAL_RA...		0		00:00:00
FC114	MCU_POWER_SUPPLY_FAULT		0		00:00:00
FC115	CELL_VOLTAGE_SENSOR_OOR		0		00:00:00
FC122	DISCONNECT_TOO_SLOW		0		00:00:00
FC123	MAIN_CONTACTOR_FAULT		0		00:00:00
FC128	CURRENT_SENSOR_LARGE_OFFSET		0		00:00:00
FC130	MULTI_STRING_ADDRESS_MISMATCH		0		00:00:00
FC131	MULTI_STRING_COMM_TIMEOUT		0		00:00:00
FC137	MCU_TEMP_BELOW_NORMAL_RANGE		0		00:00:00
FC138	MCU_TEMP_FAR_BELOW_NORMAL_RANGE		0		00:00:00
FC139	MCU_TEMP_ABOVE_NORMAL_RANGE		0		00:00:00
FC140	MCU_TEMP_FAR_ABOVE_NORMAL_RANGE		0		00:00:00
FC142	LMU_HW_OVERTEMP		0		00:00:00
FC143	PACK_OUT_OF_BALANCE		0		00:00:00
FC144	PRECHARGE_RESISTOR_PROTECTION		0		00:00:00
FC146	PRECHARGE_FAILURE		0		00:00:00
FC147	HVIL_FAULT		0		00:00:00
FC148	CONTACTOR_STATUS_MISMATCH		0		00:00:00

Fault Accommodation

Warning
Derate
Disconnect

Clear Faults

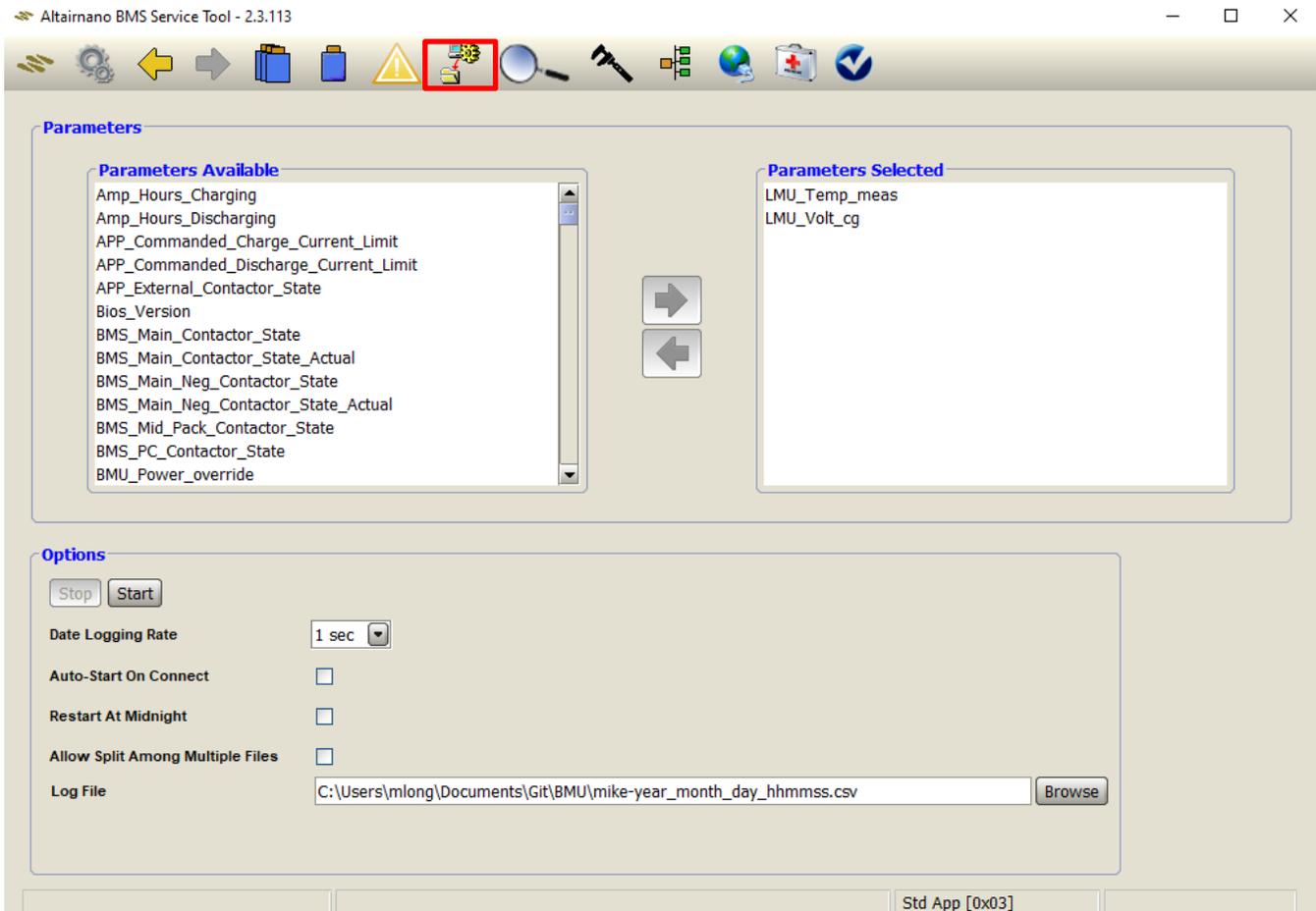
Clear Faults + History

Description:

Std App [0x03]

4.4 Data Logging Screen

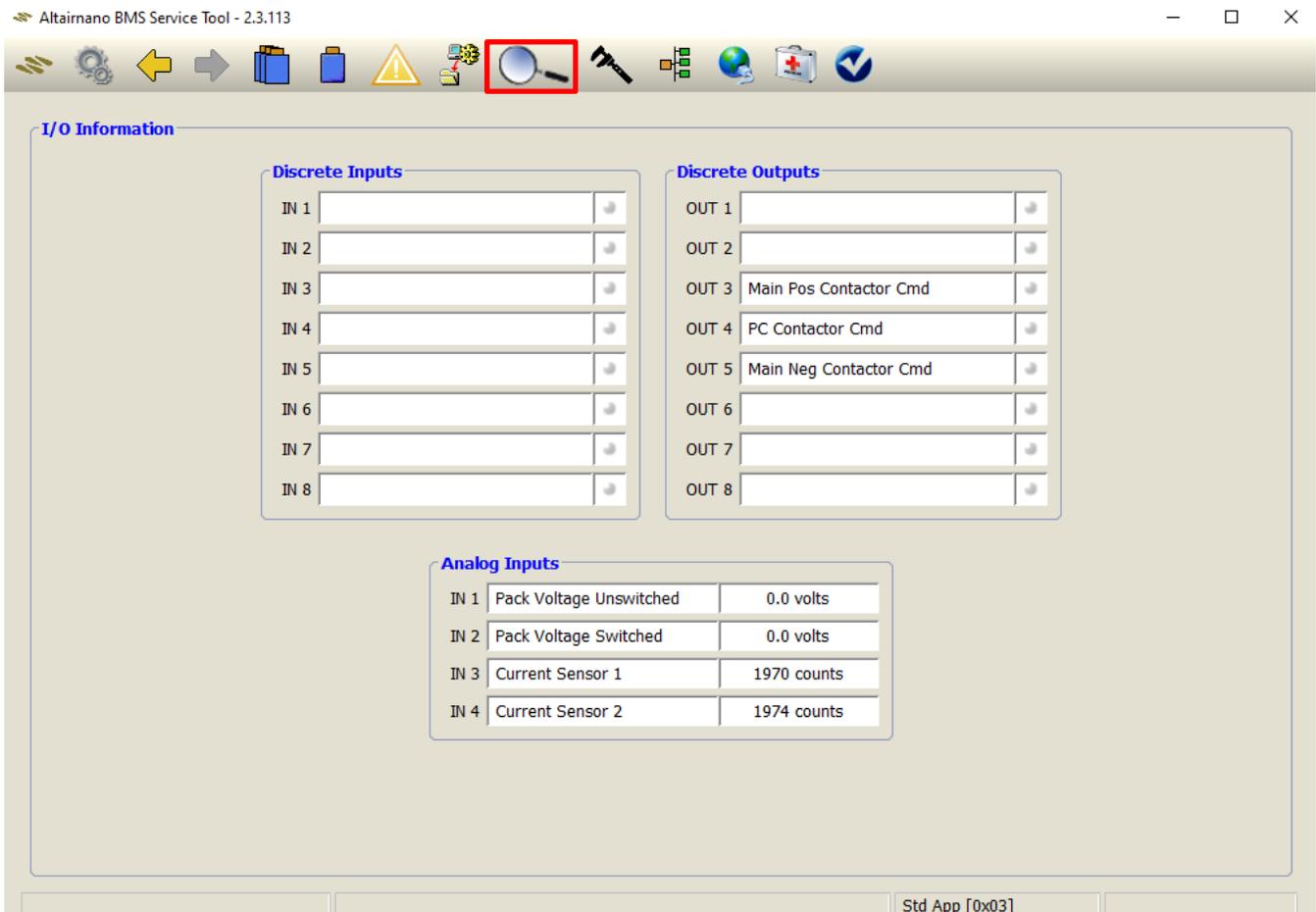
The Data Logging screen allows the logging of BMS information to a *.csv file format. The BMS Service Tool captures the BMS information periodically according to the Data Logging Rate and stores it to the selected Log File. The *.csv file can be imported to spreadsheet software like Microsoft Excel. ‘Allow split among multiple files’ selection box adds the ability to put large amounts of data in multiple files to overcome limitations importing to the spreadsheet software.



4.5 Diagnostic Information Screen

The Diagnostic Information screen gives information on the BMU inputs and outputs. The ‘Discrete Inputs’ and ‘Discrete Outputs’ frames show the state of the configured input and output ports. A green dot shows when the input or output is active. The ‘Analog Inputs’ frame shows the reading of the measured unswitched and switched pack voltages along with the A/D counts of the current sensor.

NOTE: The ‘IN 4’ reading may not be shown if the current sensor configuration is only for single channel and not dual channel.

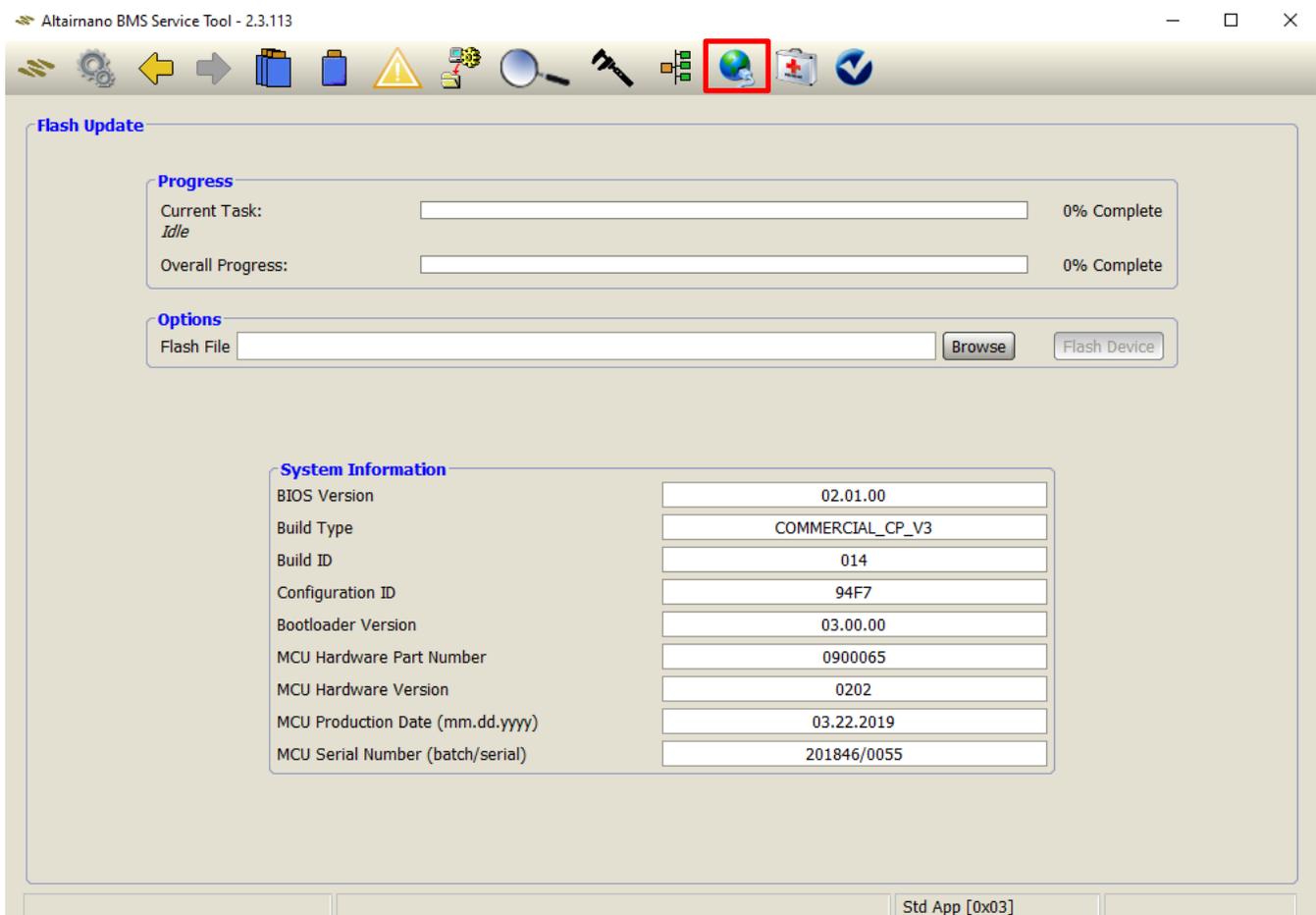


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4.6 BMU Software Update Instructions

The service tool uses a *.bms file to update the software for the BMU. This file contains the software build and configuration information that the tool uses to generate battery system specific software. This file is encrypted and cannot be viewed. The service tool verifies the *.bms file and will indicate if there is a problem with the file. Click the Flash Programming button in the BMS Service Tool.

BMU software revision information can be viewed in the ‘System Information’ frame of the Flash Programming screen.



Click the ‘Browse’ button and locate the *.bms file on the PC to flash update the BMU. **Click the ‘Open’ button** when the *.bms file is located and selected. The service tool flash programming window will display a new ‘Flash Device’ button. **Click the ‘Flash Device’ button** to program the software into the BMU.

The service tool will begin flashing the BMU with new software. The status bar will show the progress of the BMU software update. This will take a few minutes and a notification will occur when complete.

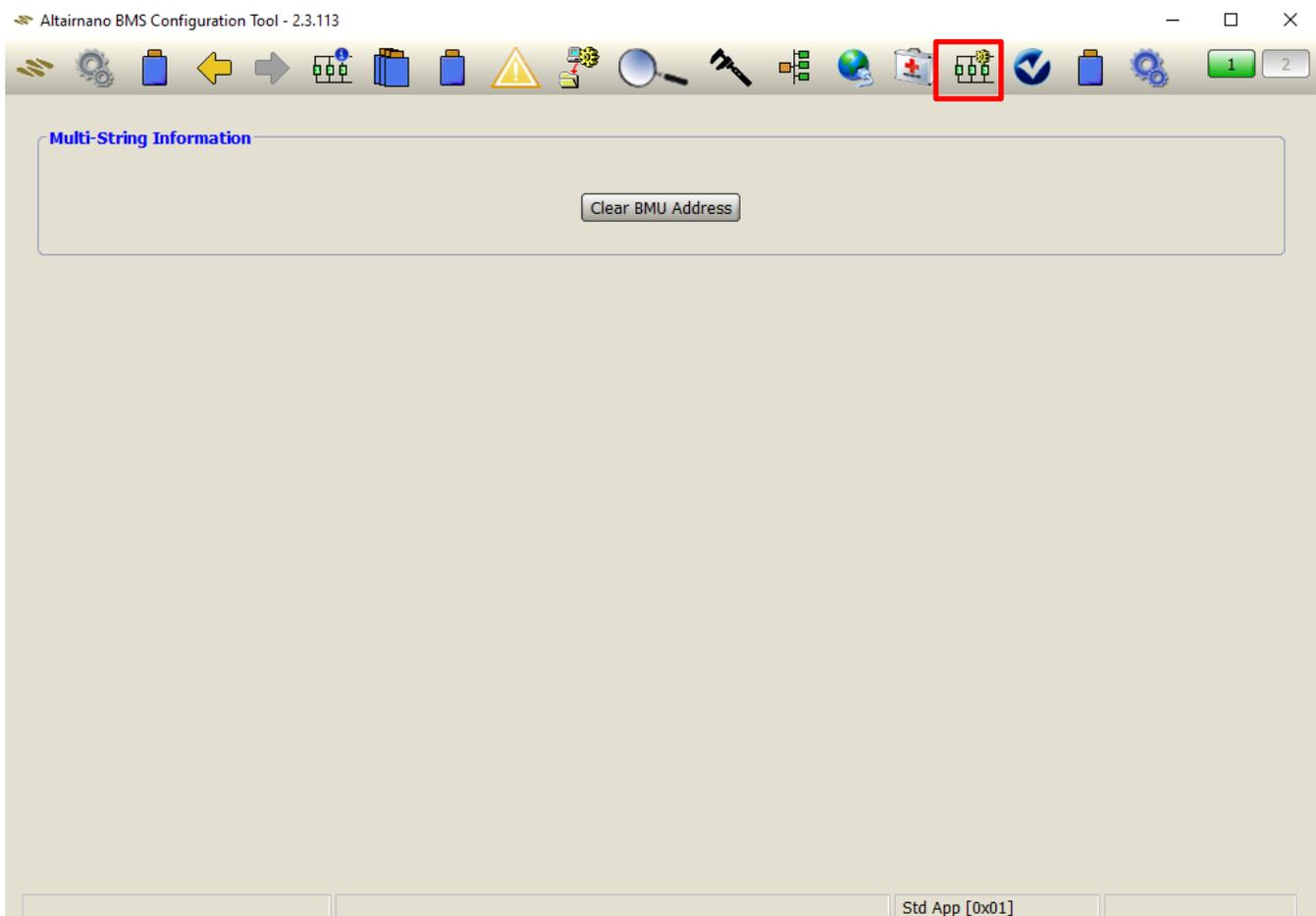
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5. Use BMS Service Tool to Configure Multi-string

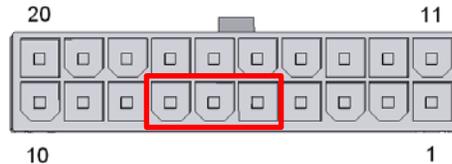
Steps involved in setting up the multi-string operation are as follows:

1. The BMU is configured to operate at address 0x01 in multi-string mode (if no input is provided to the digital inputs to select an address).
2. Update each individual BMU settings for the LMUs per the instructions in 3.4 Configuration & LMU Setup.
3. Calibrate the current sensor on each individual strings per the instructions in 3.5 Current Sensor Calibration.
4. Navigate to the 'Multi-string Configuration' screen and select 'Clear BMU Address'.



5. Switch Off the power to the BMU.
6. Go to 'Home' screen (Altairnano logo icon) and select '**Disconnect from BMS**'.

- Set the BMU address to an appropriate binary value between 0x01 and 0x06. Locate the MCON C connector on the BMU hardware. Figure below shows the MCON C connector:



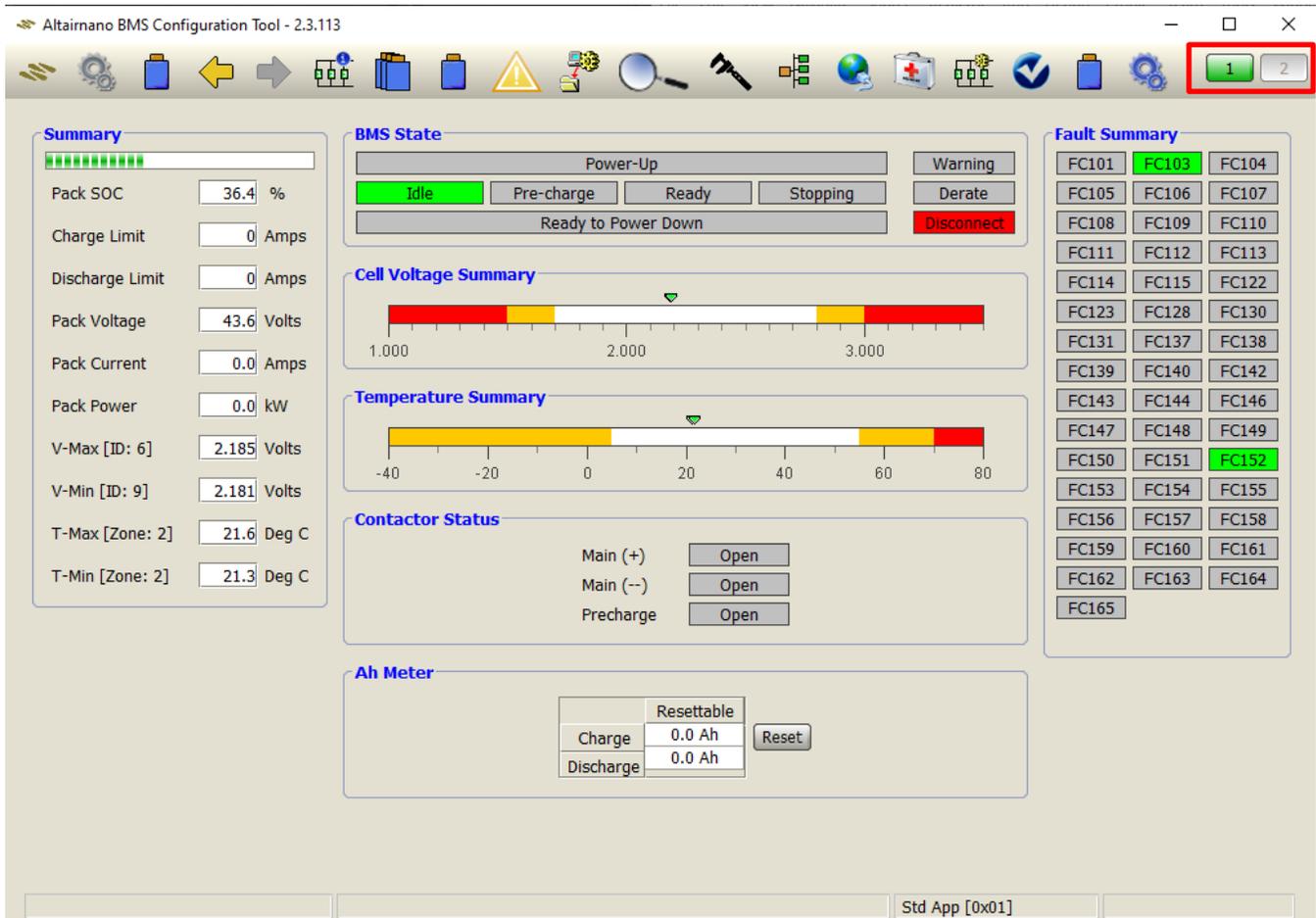
- Pins 5, 6 and 7 of the Molex connector are digital inputs 1, 2 and 3 respectively and are reserved for BMU CAN addressing in a multi-string application. In the table below ‘NC’ means No Connection and ‘High’ means 5 – 24 Vdc with a DC ground reference in one or more of these pins 1 – 4. Use the table below to configure suitable addresses for your multi-string BMU:

Pin 7	Pin 6	Pin 5	Address to communicate
NC	NC	NC	0x01
NC	NC	High	0x02
NC	High	NC	0x03
NC	High	High	0x04
High	NC	NC	0x05
High	NC	High	0x06

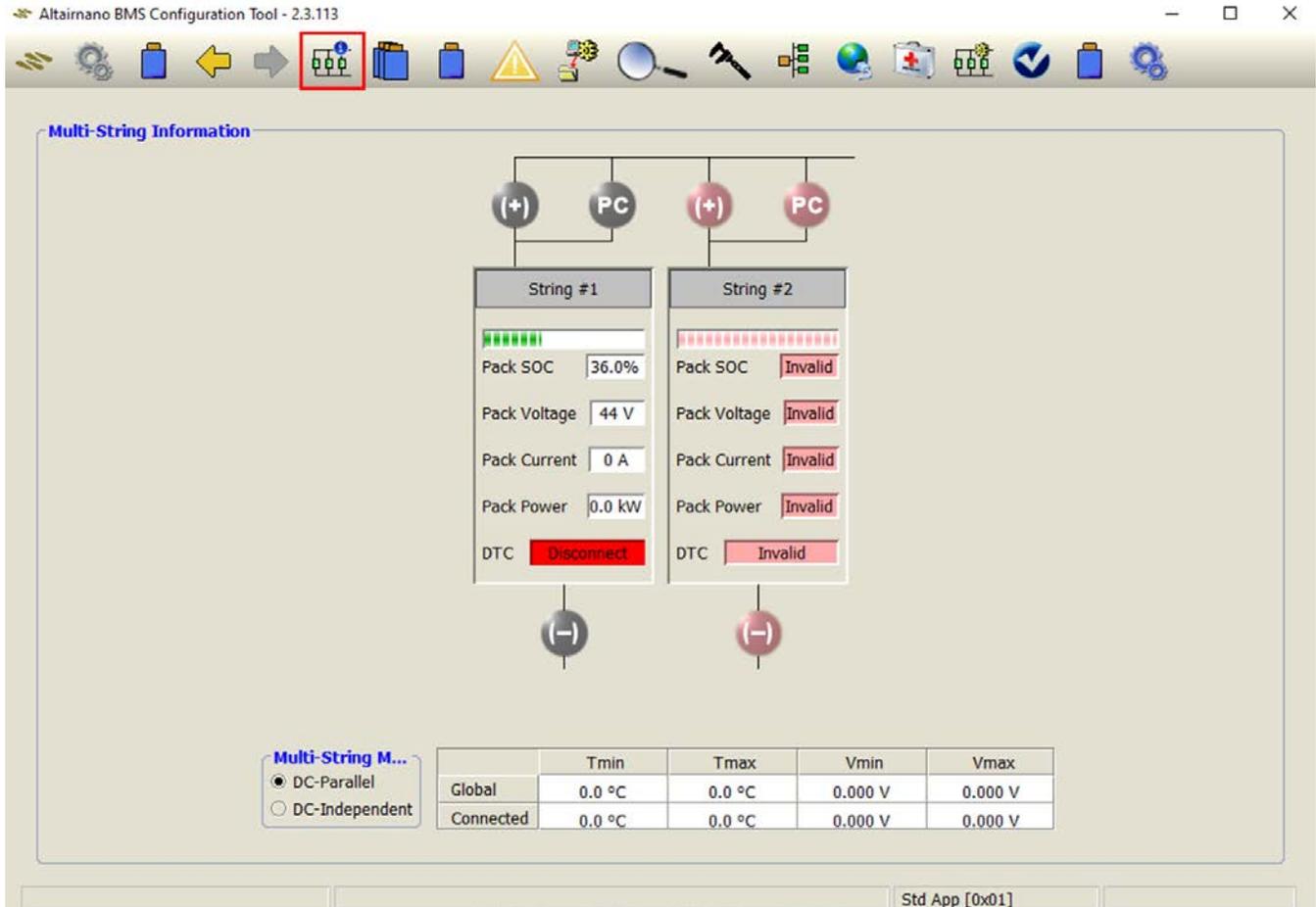
NOTE: Addresses of each string connected in a multi-string configuration shall be distinct from one another.

- Switch On the power to the BMU.
- Follow the procedure 3.2 BMS Service Tool Settings to change the BMU address. The address selected in this step must co-relate to the BMU connected to the PC.
- Navigate to the ‘Pack Summary Information’ screen. The Pack Summary Information screen displays information of the batteries that are connected to the BMU directly interfacing with the PC.

12. Use the buttons highlighted in the fig. shown below to navigate to rest of the strings connected in parallel.



13. Navigate to the 'Multi-string Information' screen. This screen displays the data related to each string connected in the parallel system.



14. Each string needs to be disconnected and individually connected to do any firmware upgrades.

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6. CAN Test Software

The CAN Test Software is intended to assist customers in identifying the parameters of the connected BMU's CAN bus. The software will report the CAN channel, CAN bus speed, and address of the BMU.

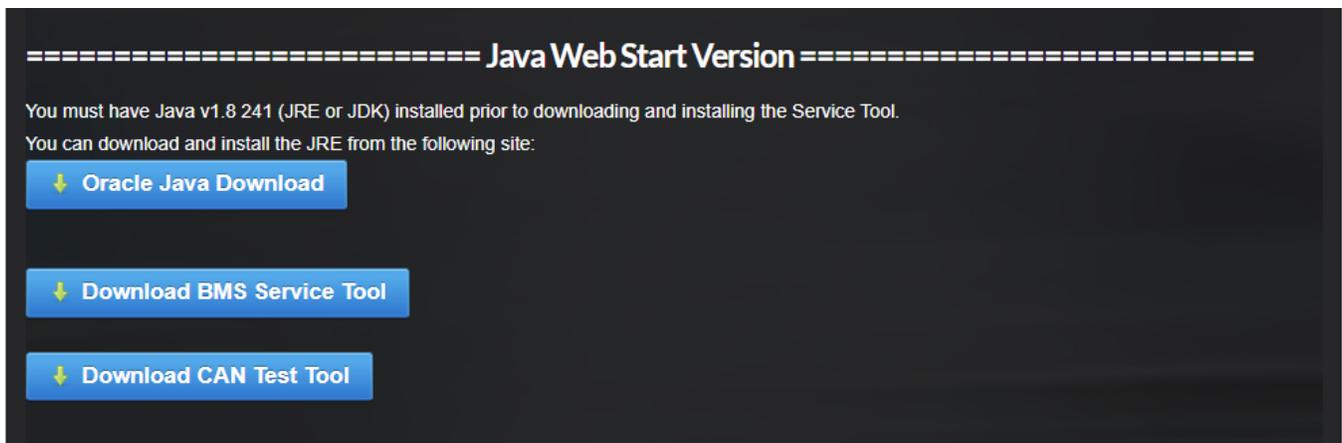
6.1 CAN Test Software Installation

There are two options for installing the CAN Test software just like with the BMS Service Tool. The Java requirements are the same as well, so if you are running the BMS Service Tool and

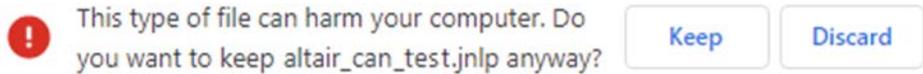
6.1.1 Java Web Start Installation

The CAN Test software can be installed from the website https://altairnano.com/service_tool/

Select the 'Download CAN Test Tool' button. Make sure to use the button in the ***“Java Web Start Version”*** section of the website.



Select the 'Keep' button.



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Select the downloaded .jnlp file.

 altair_can_test.jnlp ^

The CAN Test software should launch at this time.

6.1.2 Offline Windows Installation

Installing the Offline Windows version does **NOT** require Administrator privilege on the Windows OS. The offline installer of the BMS Service Tool can be downloaded from the website:

https://altairnano.com/service_tool/

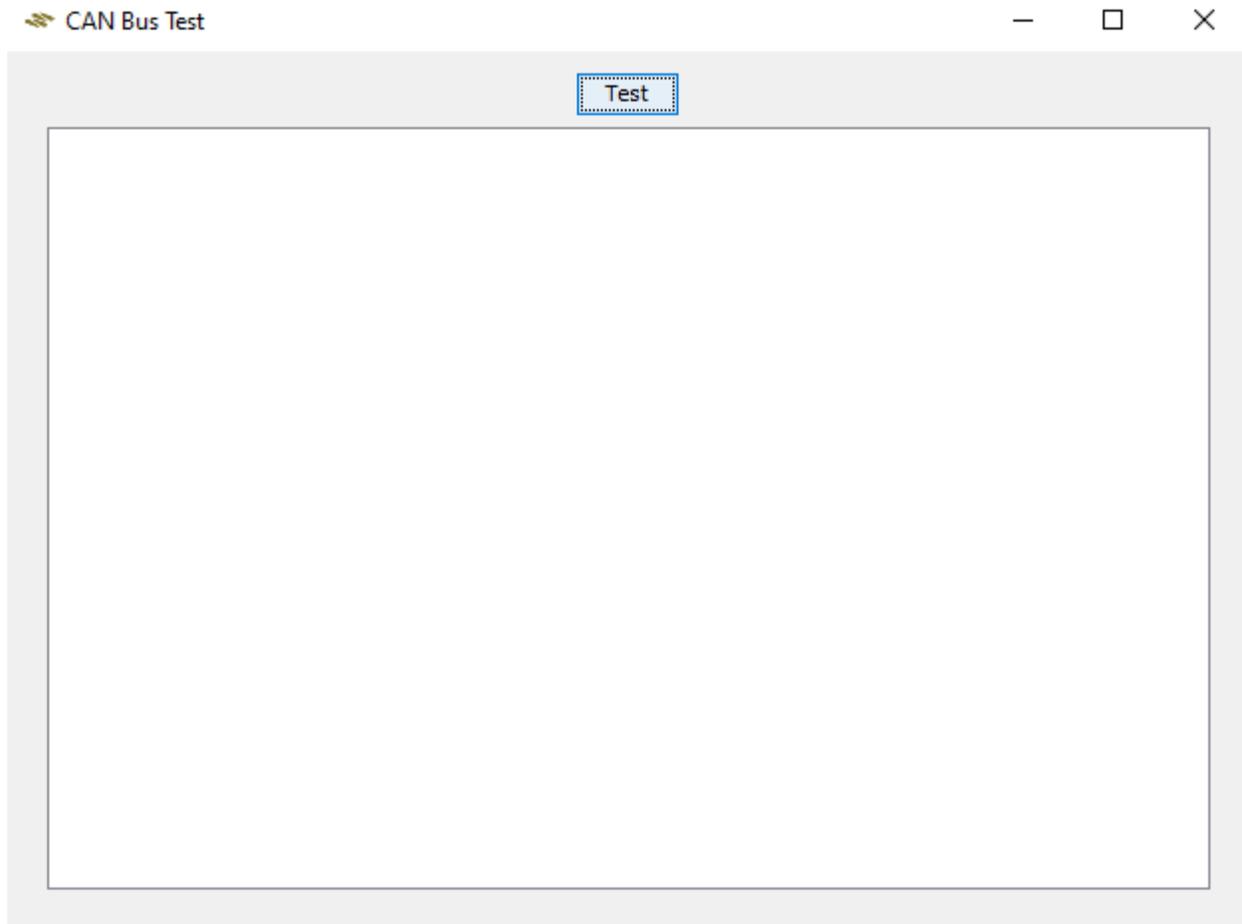
The CAN Test software installs as part of the same bundle as the BMS Service Tool software for the offline version. If you are already using that version of software, then it is already available.

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6.2 CAN Test Software Launching

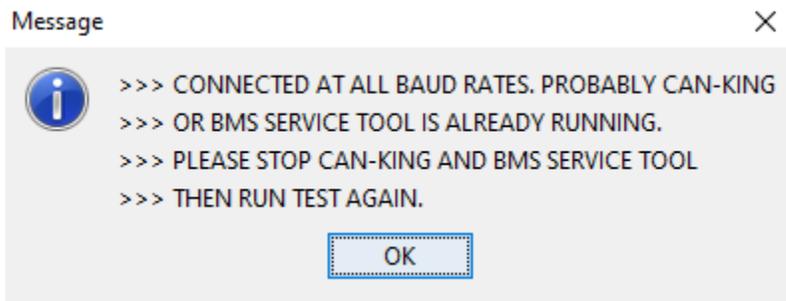
After installation, the CAN Test software can be launched by the *Altairnano CAN Test* desktop icon or *Altairnano, Inc* → *Altairnano CAN Test* start menu link. After installation the Java Web Start version will check for updates through the internet, apply any updates, and launch. If the internet is unavailable the CAN Test software will launch, but there can be a delay while the software tries to find an internet connection. For the offline Windows installer version, the software needs to be updated manually when new releases are published.



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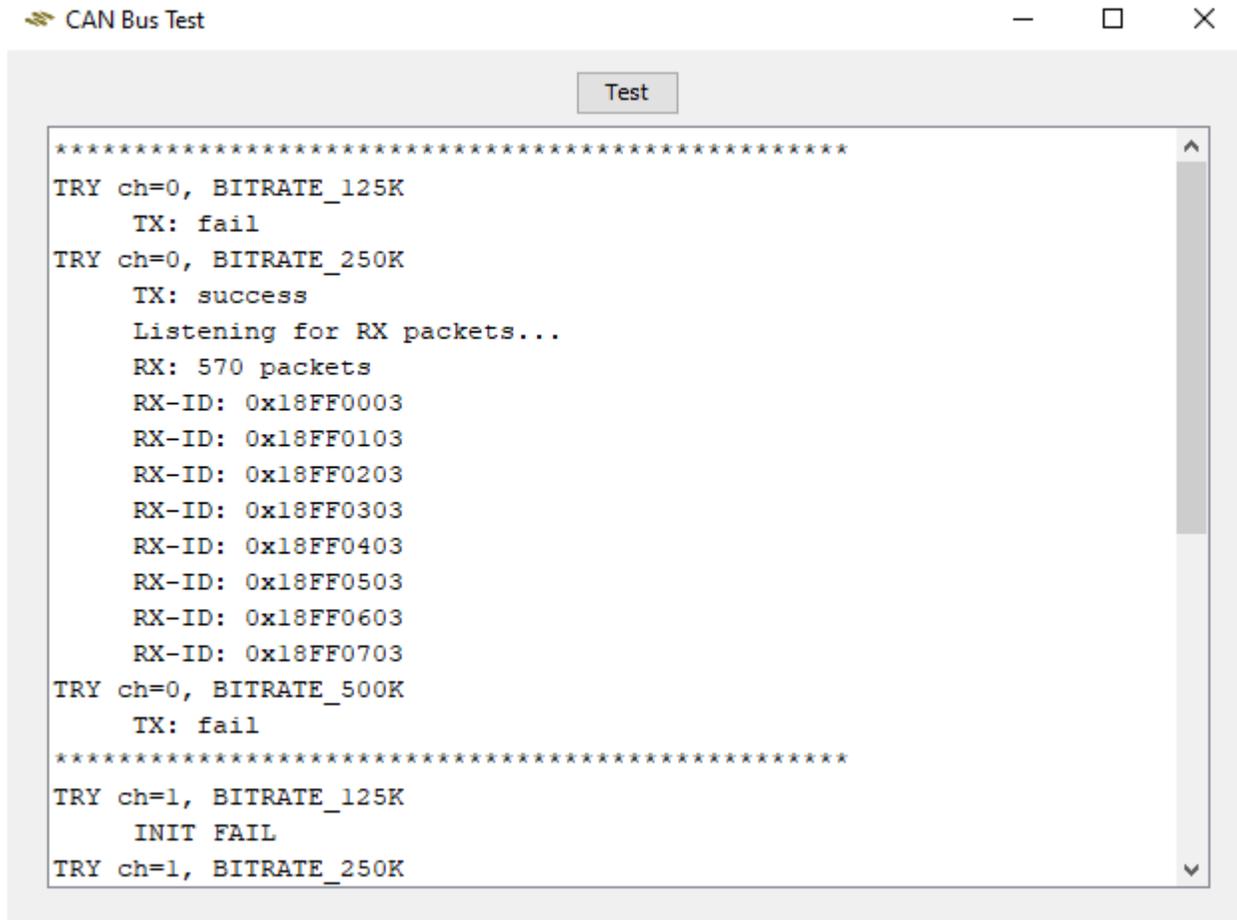
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NOTE: The CAN Test software will not function properly if the BMS Service Tool or other software is currently using or blocking the Kvaser USB to CAN device. A message similar to the following will popup if the device is blocked.



6.3 CAN Test Software Usage

Select the 'Test' button.



In the above example, the CAN Test software detected the Altairnano BMU on CAN Channel '0'. The baud rate is 'BITRATE_250K' and BMU Address is 0x03 (last 2 digits of the CAN addresses).

NOTE: A multi-string system could have more than one BMU Address shown on the messages if multiple BMUs are connected to the same CAN bus. The channel might be greater than '0' if there are more than one Kvaser CAN to USB device channels present.



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7. Revisions History

Version	Author	Date	Comment
00	J. Lyon	7/19/2010	<ul style="list-style-type: none">• Initial draft.
01	K. Tipnis	2/23/2012	<ul style="list-style-type: none">• Various updates
03	Mike Long	4/6/2021	<ul style="list-style-type: none">• Revisions to support BMS v14 release• Deployment website change
04	Tim Hoover	5/2/2024	<ul style="list-style-type: none">• Changed document structure to assist with first time setup and usage of BMS hardware• Added information about the offline Windows installation of the BMS Service Tool• Added CAN Test software sections• Changed the Java section to add information about versions and different software vendor options• Changed all 'Normal' body text to 12 point font• Added some acronyms to the definition table