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Nuvation Energy BMS Descartes Software

Release Notes

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BMS Software Version: Descartes Update 1

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Revision History

Version	Details	Date
1.0	Initial release for Descartes Update 1 firmware	2024-2-21

Introduction

This document provides a summary of software changes for the Descartes Software release.

Nuvation Energy Software Release Naming Convention

Nuvation Energy BMS software releases have *names* along with *version numbers*. The release names are in alphabetical order to easily identify newer releases. For example: Ampere -> Babbage -> Curie.

Descartes Update 1

Applies to stack-level products like:

- G4 Stack Switchgear
- Stack Controller and Power Interface (modules only)
- Low-Voltage BMS

Finding the currently installed version

To find the current version of software installed on your Battery Management System:

- At the stack-level, check the *Service* screen in the Operator Interface.

UL 1973 compatibility

The Descartes Update 1 release is compatible for UL 1973 certification.

Stack-Level

To maintain firmware compliance for the UL 1998 safety assessment, the stack-level firmware must maintain a specific CRC on its program image. The Descartes release has completed UL 1998 functional safety to allow for compliance to higher level UL standards (such as UL 1973). The functional safety applies to all products listed in the *Introduction*.

The *Nuvation Energy BMS: Gen 4 Safety Manual* was created to guide Nuvation Energy BMS owners on how to configure their system to comply with a UL 1973 review. This is a step by step instruction manual that provides a check list of configuration steps that the UL reviewer will request.

Please contact support@nuvationenergy.com for access to the *Nuvation Energy BMS: Gen 4 Safety Manual*.

Upgrading your Battery Management System

If you would like to upgrade your G4 Stack Switchgear, please contact support@nuvationenergy.com for assistance with the upgrade process. These products are customized for their specific end-application and require additional considerations in the upgrade process.

Upgrades from releases prior to Descartes can use the Quick Start Wizard to generate a representative Descartes configuration to start from. The Quick Start Wizard may be accessed online through https://ncloud.nuvationenergy.com.

Operational configuration from a prior pre-Descartes configuration can be transferred to this Descartes configuration file using your *Product Manual*.

We thrive on your feedback and what we build is driven by your input.
Please submit support tickets to support@nuvationenergy.com.

Descartes Update 1

The software changes for Descartes Update 1 are with respect to the Curie Update 1 software release.

New Features

The following features were introduced into Descartes Update 1

1. Added safety function for contactor life tracking
2. Added an adaptive SOC algorithm
3. Added a hysteresis to the stack full current condition

Contactor Life Tracking

A new safety function was added to the BMS firmware to track the life of contactors. The tracking of contactor life is required for all G4 Stack Switchgear products. Stack designs which use either the Stack Controller or Low-Voltage BMS products must assess their own contactors used and decide if this feature should or should not be applied.

G4 Stack Switchgear products have different life configurations for their contactors. The *Nuvation Energy BMS: Gen 4 Safety Manual* provides guidance on how to configure contactor life tracking feature for all of Nuvation Energy's Battery Management System products.

The accumulated life of the contactors is persisted in non-volatile memory. When the life reaches the maximum configurable limit, a corresponding warning/fault will be triggered. These warning/faults can not be cleared and the G4 Stack Switchgear unit must be returned to Nuvation Energy to assess damage and replace all contactors.

During operation, the life for a set contactors is increased under two conditions:

1. When contactors are opened above a minimum current threshold. The amount of life increase will be reflected on the magnitude of the breaking current.
   - Above a minimum opening current threshold and below a maximum opening current threshold, contactor life is incremented by one unit.
   - Above a maximum opening current threshold, the life is increased by the maximum life of the contactors. This condition will cause the contactor life fault to trigger.
2. A BMS stack loses power when the contactors are in a closed state. The amount of the life increase will be a single unit as the current information is lost and can not be determined.

It is highly recommended to apply a Uninterrupted Power Supply (UPS) to the Battery Management System input power to prevent a contactor life increment due to a loss of power when contactors are closed.

Adaptive SOC Algorithm

An adaptive SOC algorithm was added to the Nuvation Energy BMS and is continuing to be tested and

evolved for different battery chemistries. This algorithm attempts to adapt SOC to remove integration errors that can occur over a long operational time frame when a battery does not reach is full/empty states. By default this algorithm is disabled. However it is possible to execute both the original cumulative coulomb counting and the adaptive SOC algorithm at the same time. An operator can select which algorithm will be output its results to the `stack_soc[0].soc` and `stack_soc[0].dod` registers and corresponding MESA points. For more information on how to use this algorithm please contact support@nuvationenergy.com.

The adaptive SOC algorithm is not currently recommended for LFP battery chemistries.

Improved Stack Full Condition

A time hysteresis was added to the *iFull* to enforce a minimum duration of charging current before considering the stack is at a full condition (100% SOC). The additional configuration register settings are available to configure this additional constraint.

1. `stack_soc.ifull_period` is the hysteresis period for the current to be between the following range. The `ifull_period` register has units of microseconds.
2. When the charge current is between the `stack_soc.ifull` and negative `stack_charge_status.hold_current` for the minimum duration of `stack_soc.ifull_period` before the stack is considered full.

The registers `stack_soc.vfull` and `stack_soc.vfullavg` provide additional constraints on the stack full condition. Refer to the appropriate Battery Management System Product Manual for further details on the stack full state configuration.

Resolved Issues

The following bug fixes were corrected in the Descartes Update 1 release.

1. Flash drivers failed to report some write/erase failures.
2. Pre-Charge configuration updated to prevent incorrect operation.
3. Removed a small drift in the Stack Controller and Power Interface software clocks (always slower than wall clock).
4. Modbus-RTU handler could experience a buffer under-flow for malformed packets.
5. Added a configurable connect delay for each contactor.
6. Allow product maximum for G4 Cell Interface modules. Previous G4 Cell Interface limits were one less than maximum.
7. Contactors would not close for 8 seconds after exiting service lockout
8. Reject invalid stack voltage measurements immediately after initialization of AFE
9. SOC reporting at 100% while DoD significantly declines.
10. Improved BMS stack simulation

From time to time Nuvation Energy will make updates to products in response to changes in available technologies, client requests, emerging energy storage standards, and other industry requirements. The product specifications in this document, therefore, are subject to change without notice.