



Nuvation Energy Cell Interface

NUV100-CI Datasheet

Document ID: NE-DS-003 | Revision: 2.1, 2020-05-06

Table of Contents

- 1. System Overview 1
- 2. External Interfaces 3
 - 2.1. Battery Cells 3
 - 2.2. Temperature Sensors 3
 - 2.3. Link In 4
 - 2.4. Link Out 4
 - 2.5. Indicator LEDs 4
- 3. Operating Limits 5
 - 3.1. Electrical Characteristics 5
 - 3.2. Environmental Conditions 6
 - 3.3. Maximum Stack Deployment 6
- 4. Mechanical Overview 8
 - 4.1. Optional DIN rail mounting Kit 9
- 5. Ordering Information 11

1. System Overview

The Nuvation Energy Cell Interface is one of several major components of a Nuvation Energy battery management system. The Cell Interface is the direct link between the battery stack cells and the rest of the battery management system. It facilitates battery monitoring and control functionalities.

This datasheet outlines the external interfaces, operating limits, mechanical data, and ordering information of the Cell Interface. A basic system diagram is shown in [Figure 1](#).

The Cell Interface is compatible for use with both the Nuvation Energy High-Voltage BMS or the Low-Voltage BMS.

In a High-Voltage BMS, depending on battery stack size and count, one or more Cell Interface modules are used to convert and relay cell voltage and temperature readings digitally to the Stack Controller. When using multiple Cell Interface modules, the same Cell Interface variant must be used - i.e. all NUV100-CI-12-1 or all NUV100-CI-16-1 or all NUV100-CI-4M12-1.

In a Low-Voltage BMS a larger battery stack can be accommodated with the addition of one Cell Interface module, provided the total stack voltage does not exceed maximum rating of the default configuration. When coupled with a Battery Controller, the Cell Interface model must match the Battery Controller model - i.e. A Battery Controller - 12 channel can only be coupled with a Cell Interface - 12 channel and a Battery Controller - 16 channel can only be coupled with a Cell Interface - 16 channel.



Datasheets and Installation Guides for the High-Voltage BMS and Low-Voltage BMS are available at: <https://www.nuvationenergy.com/technical-resources>.

There are 3 major variants of the Nuvation Energy Cell Interface:

1. **Cell Interface - 12 channel** (NUV100-CI-12-1)
 - monitors up to 12 series-connected cells
2. **Cell Interface - 16 channel** (NUV100-CI-16-1)
 - monitors up to 16 series-connected cells
3. **Cell Interface - 12V 4 channel** (NUV100-CI-4M12-1)
 - monitors up to 4 series-connected 12V lead-acid cells

See [Section 4](#) for details regarding mounting options, and [Section 5](#) for ordering details.

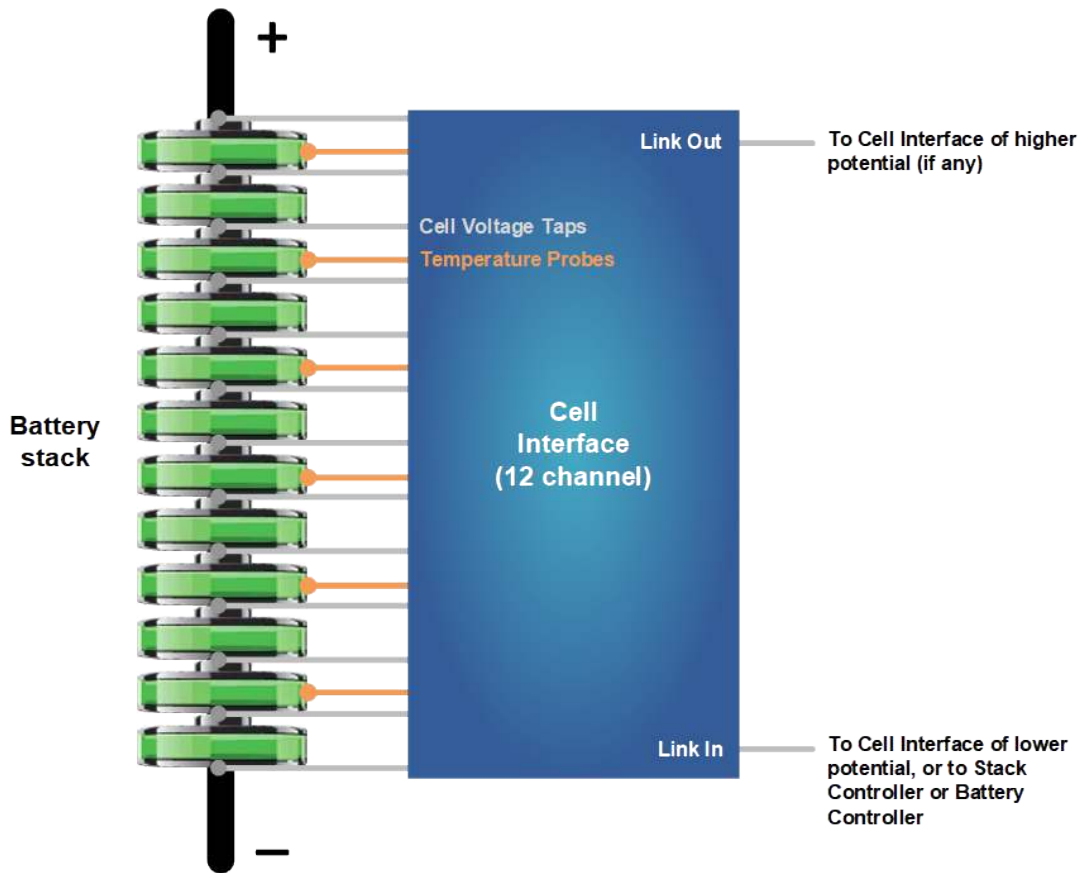


Figure 1. Cell Interface System Diagram



Cell Interface installation guides for High-Voltage BMS and Low-Voltage BMS applications are available at: <https://www.nuvationenergy.com/technical-resources>.

2. External Interfaces

The external interfaces of the Cell Interface module are:

- Battery cells connector
- Temperature sensors connector
- 2 Link Bus connectors
- 2 Indicator LEDs



The Cell Interface connects to the battery stack-referenced signals through high-voltage rated connectors. Safety precautions are required to handle and connect cables into this module.

2.1. Battery Cells

The Battery Cells connector is an 18-pin Micro-Fit 3.0™ Molex connector. This interface is used to connect the battery cell voltage sense wires to the module's measurement and balancing circuitry. If cell balancing is used, these wires carry the balancing current, and should be sized appropriately.

The cells connected to each Cell Interface module are referenced from the negative end of the most negative cell to the Cell Interface's CELL0 input.



Balancing is not supported by the 12V 4 channel Cell Interface (NUV100-CI-4M12-1) variant.

When not powering the Cell Interface module from the Link Bus:

- For the NUV100-CI-12-1 variant, a minimum of 11 V must be present between the CELL0 input and the most positive connected cell.
- For the NUV100-CI-16-1 and NUV100-CI-4M12-1 variants, cells are connected as two groups; a minimum of 11 V must be present between the most negative and most positive cells of each group.

There is no minimum cell voltage requirement when powering the Cell Interface module from the Link Bus.

2.2. Temperature Sensors

The Temperature Sensors connector is a 16-pin Micro-Fit 3.0™ Molex connector. This interface is used to connect up to eight 10 kΩ NTC thermistors to the Cell Interface module. Because the sensors are referenced to the CELL0 input on the Cell Interface, care must be taken to ensure that they are electrically isolated from any common or ground potential, and from all other cell voltage terminals of all Cell Interface modules in the system. These sensors are used by Nuvation Energy BMS to detect over and under temperature conditions.



2 to 7 thermistors are supported to accommodate systems requiring Nuvation Energy BMS to meet functional safety requirements.

2.3. Link In

The Link In connector is a 4-pin Micro-Fit 3.0™ Molex connector. This interface is used, with Link Bus cables, to connect each Cell Interface in series to the Cell Interface of the next lowest potential, and the Cell Interface of the lowest potential to the Stack Controller or Battery Controller for high- or low-voltage applications, respectively. In this series connected chain of modules, each connection is made from the Link In connector of the module with higher potential to the Link Out connector of the module with lower potential.

In high-voltage applications, the Cell Interface also accepts power from its Link In connector to power itself and any Cell Interface modules of higher potential (i.e. connected to its Link Out connector).



When using the Cell Interface as an expansion module for the Low-Voltage Battery Controller, please note that the Cell Interface cannot be powered from the Battery Controller using the Link Bus.

2.4. Link Out

The Link Out connector is a 4-pin Micro-Fit 3.0™ Molex connector. This interface is used to provide a data channel and power source to higher-potential Cell Interface modules in the chain. The Link Out connector is to be unconnected if the Cell Interface has the highest potential in the chain.

2.5. Indicator LEDs

The 2 LEDs are used by the Cell Interface to provide a rudimentary indication of the functional status of the module. The Activity LED indicates that the Cell Interface module has received a communication packet from the Stack Controller or Battery Controller via the Link Bus. The Fault LED indicates Nuvation Energy BMS has detected a fault condition in the system.

3. Operating Limits



Exceeding the maximum ratings will damage the module.

3.1. Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Link In Specifications						
+V _{BUS}	Input Voltage	-	9	24	60	Vdc
	Input Current, CI-12	+VBUS = 24Vdc, Link Out disconnected	-	-	25.5	mAdc
	Input Current, CI-16	+VBUS = 24Vdc, Link Out disconnected	-	-	31.7	mAdc
I _{P_LINK}	Output Current	-	-	-	20	mAdc
I _{N_LINK}	Output Current	-	-	-	20	mAdc
Link Out Specifications						
+V _{BUS}	Output Voltage	-	-	+VBUS	-	Vdc
	Output Current	+VBUS = 24Vdc	-	-	31.7	mAdc/ CI-16
I _{P_LINK}	Output Current	-	-	-	20	mAdc
I _{N_LINK}	Output Current	-	-	-	20	mAdc
Battery Cells Specifications						
C _(n) - C _(n-1)	Input Cell Voltage Range	+VBUS = 24Vdc	0	-	5	Vdc
V _{sum}	Voltage between C0 and C12	CI-12, +VBUS = 0Vdc	11	-	60	Vdc
	Voltage between C0 and C8	CI-16, +VBUS = 0Vdc	11	-	40	Vdc
	Voltage between C8 and C16	CI-16, +VBUS = 0Vdc	11	-	40	Vdc
	Voltage between C0 and C2	CI-4M12, +VBUS = 0Vdc	11	-	40	Vdc
	Voltage between C2 and C4	CI-4M12, +VBUS = 0Vdc	11	-	40	Vdc
TME	Total Measurement Error	CI-12, CI-16, +VBUS = 24Vdc	±0.1	±1.2	±1.6	mVdc
	Total Measurement Error	CI-4M12, +VBUS = 24Vdc	±2.0	±8.0	±10.0	mVdc
I _(n)	Cell Balancing Current (only for CI-12 and CI-16)	C _(n) - C _(n-1) = 4Vdc	304	307	310	mAdc
Temperature Sensors Specifications						
I _(n)	Output Current to Temperature Sensor	-	-	-	300	uA
R _{t(n)}	Temperature Sensor Resistance at 25°C	-	-	10	-	kΩ
T _(n)	Input Temperature Sensor Voltage Range	Cell 0 = 0V	0	-	3	V

3.2. Environmental Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Thermal Specifications						
T _a	Operating Temperature	-	-10	25	60	°C
	Storage Temperature	-	-10	25	60	°C
Humidity Specifications						
RH	Operational RH	-	5	-	85	%
	Storage RH	-	5	-	85	%
Shock and Vibration Specifications						
Vertical	Vertical shock/vibration	-	-	-	1	m/s ²
Longitudinal	Longitudinal shock/vibration	-	-	-	1	m/s ²
Transverse	Transverse shock/vibration	-	-	-	1	m/s ²

Nuvation Energy Cell Interface meets CISPR 22 Class A and IEC/EN 61000-4-2 industry standards for EMC/EMI and ESD respectively.

Nuvation Energy Cell Interface has been designed to meet EN 60950 high voltage creepage/clearance distances to prevent arcing to the metal enclosure.

All components are EU RoHS/China RoHS compliant.

3.3. Maximum Stack Deployment

Nuvation Energy Cell Interface are deployed as a daisy chain to monitor the cells of a stack. The maximum number of modules that are supported in a stack depend on two metrics:

- the maximum number of modules that can be powered over linkbus power (if required)
- the required scan rate of the cell voltage measurements

3.3.1. Limits Due to Link Bus Power

Max CI-12	Max CI-16	Max CI-4M12
50	40	40

3.3.2. Limits Due to Cell Voltage Scan Rate

The following are approximate cell voltage scan rates for different lengths of CI daisy chains where all cells are installed. They are provided for reference only and can vary depending by functionality enabled on the Stack Controller.

Table 1. Cell Voltage Scan Rates for Cell Interface - 16 channel and Cell Interface - 12V 4 channel

LP Filter	CI Chain Length	Scan Rate [Hz]
7 kHz	1	5.53
7 kHz	5	3.32
7 kHz	10	2.22
7 kHz	15	1.74
7 kHz	20	1.38
7 kHz	25	1.15
7 kHz	30	0.91
26 Hz	1	1.55
26 Hz	5	1.31
26 Hz	10	1.11
26 Hz	15	0.98
26 Hz	20	0.84
26 Hz	25	0.76
26 Hz	30	0.63

Table 2. Cell Voltage Scan Rates for Cell Interface - 12 channel

LP Filter	CI Chain Length	Scan Rate [Hz]
7 kHz	1	6.01
7 kHz	5	3.94
7 kHz	10	3.03
7 kHz	15	2.59
7 kHz	20	1.97
7 kHz	25	1.63
7 kHz	30	1.44
7 kHz	35	1.30
7 kHz	40	1.08
26 Hz	1	1.58
26 Hz	5	1.38
26 Hz	10	1.26
26 Hz	15	1.14
26 Hz	20	1.00
26 Hz	25	0.94
26 Hz	30	0.86
26 Hz	35	0.80
26 Hz	40	0.72

4. Mechanical Overview

The overall dimensions of the Cell Interface are 104.4 mm X 121.58 mm X 40.6 mm.

The Cell Interface is available in a bulkhead-mountable enclosure as shown in [Figure 2](#). The enclosure has five metal walls, leaving the bottom of the unit fully exposed. It must be mounted to a metal bulkhead panel such that the panel covers the exposed bottom side.

The NUV100-CI-12-1 and NUV100-CI-16-1 variants produce up to 24 W and 32 W, respectively, during cell balancing. A portion of this heat is transferred to the bulkhead.

Extra space should be provided around the module to allow for easy installation/maintenance.

The standard Cell Interface, Bulkhead weighs approximately 450 g.



The Cell Interface contains high-voltage signals reaching as high as 1250 V DC. Care must be taken when mounting the PCB into a metal enclosure to ensure that the metal walls remain a safe distance from the exposed conductor on the PCB.

Using 1250 V DC as an example, the metal walls of the enclosure must be at least 4.2 mm from the nearest exposed conductor and must not touch the PCB or any component on the PCB, including the connector housings.

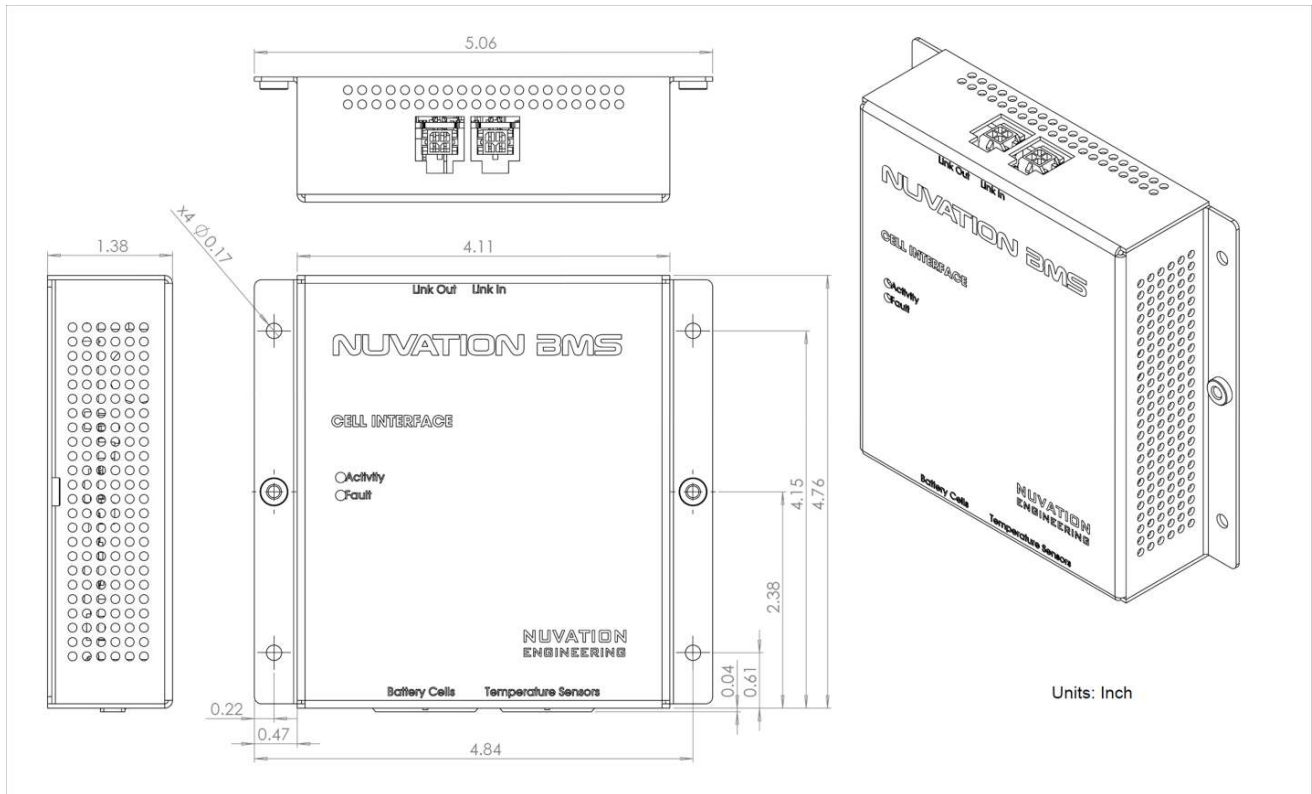


Figure 2. Mechanical Drawing of Cell Interface with Bulkhead Enclosure

4.1. Optional DIN rail mounting Kit

For applications requiring DIN rail mounting, the Cell Interface may be ordered with the Cell Interface Mounting Bracket (Bulkhead-to-DIN) kit. This kit is sold separately, and includes a metal plate and the necessary hardware to securely mount the standard Cell Interface module to EN50022-compliant DIN rails, as shown in [Figure 3](#).

The Mounting Bracket kit assembly adds an extra 14.2 mm to the overall width of the Cell Interface module, bringing it from 104.4 mm to 118.6 mm. The kit assembly holds the module approximately 7 mm away from the inside lip of the DIN rail.

The Mounting Bracket offsets the Cell Interface module from the center of the DIN rail approximately 30 mm upwards as shown in [Figure 3](#).

A Cell Interface with the Mounting Bracket weighs approximately 540 g.

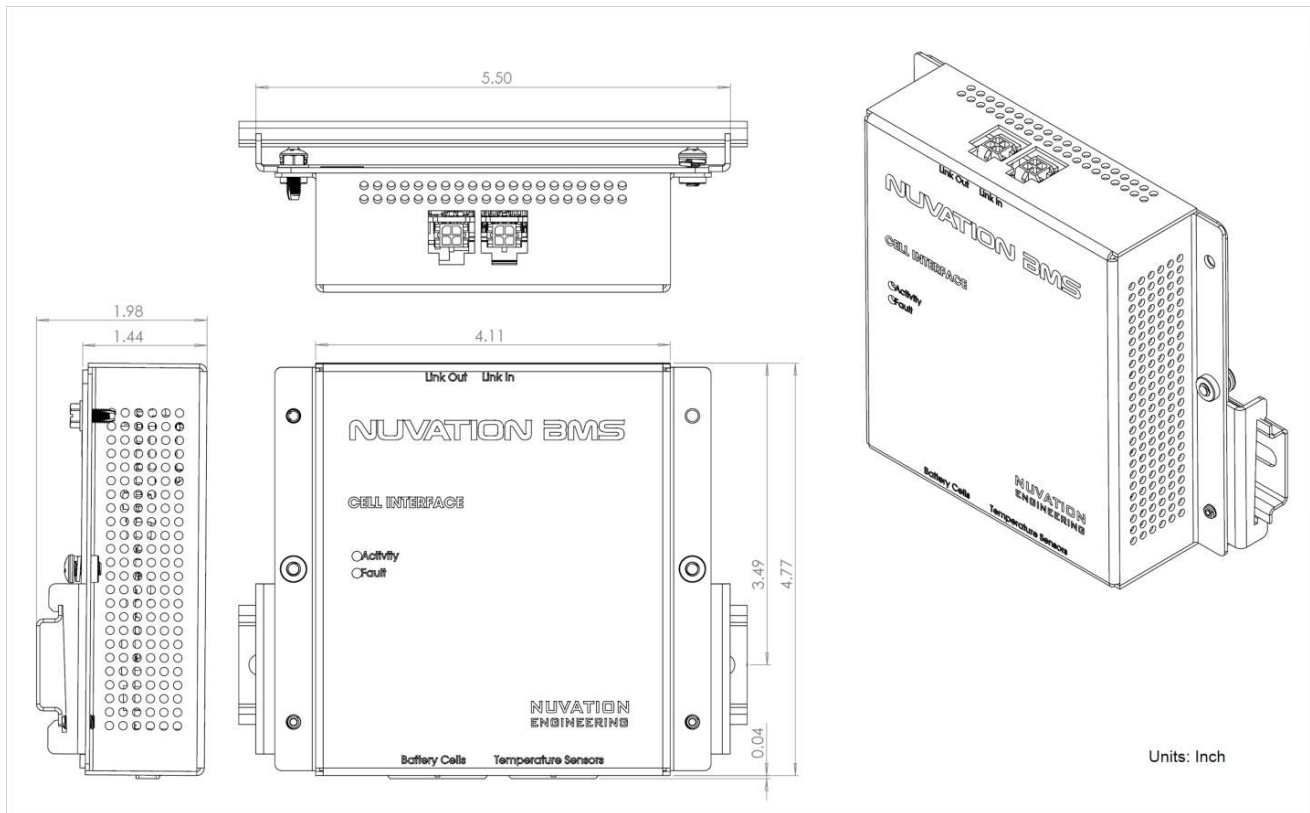


Figure 3. Mechanical Drawing of Cell Interface with Cell Interface Mounting Bracket (Bulkhead-to-DIN)

4.1.1. NRND variant with DIN rail mounting

The older Cell Interface, DIN Mount variant has been discontinued and is NRND (not recommended for new design). New designs should use Cell Interface, Bulkhead variant with the Cell Interface Mounting Bracket (Bulkhead-to-DIN) kit. The information below is provided for the purpose of updating DIN rail mechanical designs.

The clips add an extra 19.6 mm to the overall width of the standard Cell Interface module, bringing it

from 104.4 mm to 124 mm. The clips also hold the module approximately 7mm away from the inside lip of the DIN rail. The DIN enclosure vertically centers the module over the DIN rail, as shown in [Figure 4](#).

A Cell Interface with DIN mountable enclosure weighs approximately 540 g.

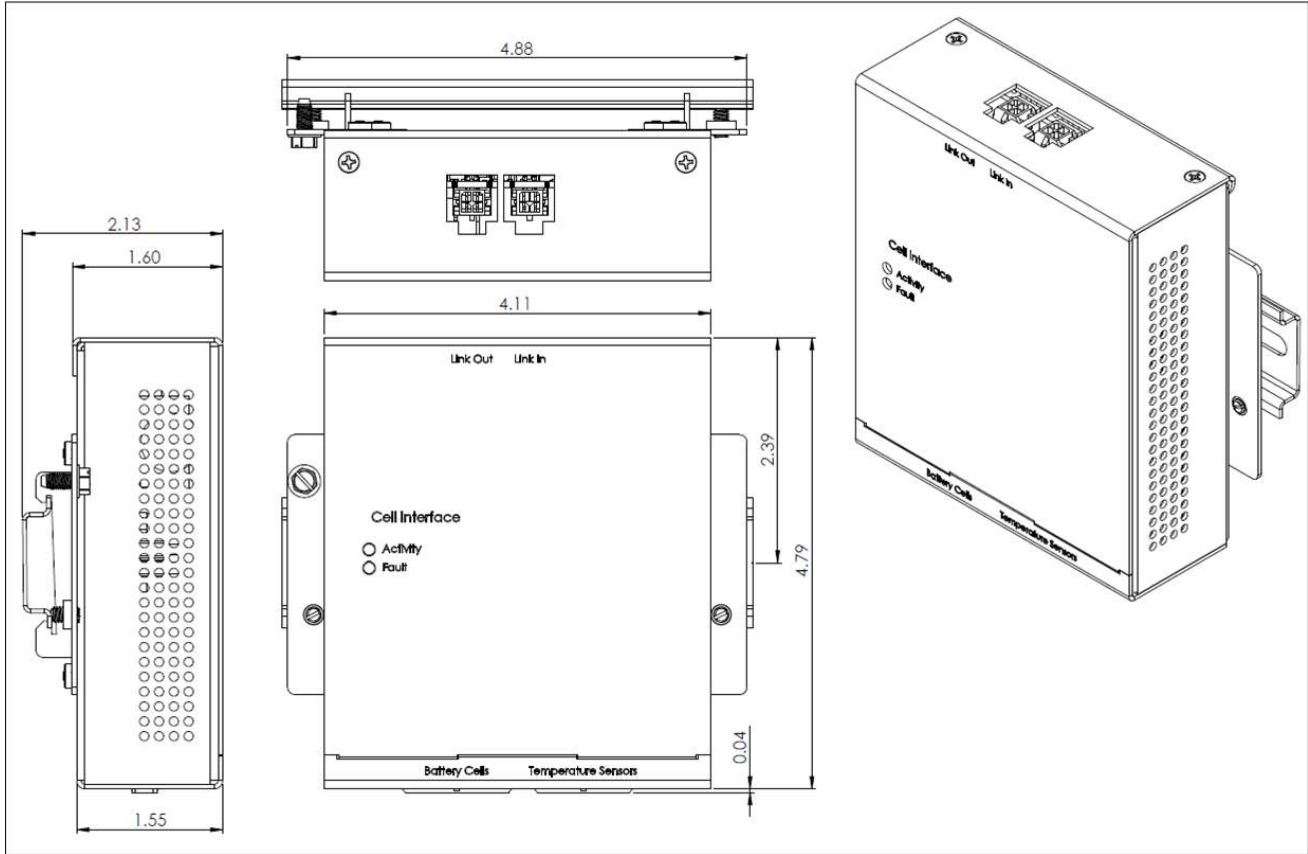


Figure 4. Mechanical Drawing of Cell Interface with DIN Enclosure (NRND)

5. Ordering Information

Product part numbers for ordering a Cell Interface are listed in [Table 3](#). Accessory kits are listed in [Table 4](#).



Cell Interface starter kits, which include the module and cables, are available to get you started quickly. Please visit <https://nstore.nuvationenergy.com> for more details.

Table 3. Ordering Information

Part Number	Product Name
NUV100-CI-12-1	Cell Interface - 12 channel, Bulkhead
NUV100-CI-12-U	Cell Interface - 12 channel, PCB assembly only (no enclosure)
NUV100-CI-12	Cell Interface - 12 channel, DIN Mount*
NUV100-CI-16-1	Cell Interface - 16 channel, Bulkhead
NUV100-CI-16-U	Cell Interface - 16 channel, PCB assembly only (no enclosure)
NUV100-CI-16	Cell Interface - 16 channel, DIN Mount*
NUV100-CI-4M12-1	Cell Interface - 12V 4 channel, Bulkhead
NUV100-CI-4M12-U	Cell Interface - 12V 4 channel, PCB assembly only (no enclosure)
NUV100-CI-4M12	Cell Interface - 12V 4 channel, DIN Mount*

* DIN Mount variants have been discontinued and are NRND (not recommended for new design). See [Section 4.1.1](#) for details.

Table 4. Accessory Kits

Part Number	Product Name
NUVP-CI-DIN-MB	Cell Interface Mounting Bracket (Bulkhead-to-DIN)

From time to time Nuvation Energy will make updates to Nuvation Energy BMS 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.

© 2020 Nuvation Energy