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Nuvation Energy G4 High-Voltage BMS

NUV100 Modules Datasheet

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1. System Overview

The Nuvation Energy G4 High-Voltage BMS family includes several modules that operate together as a complete system. Available modules are listed below.

Table 1. G4 High-Voltage BMS Modules

Model	Module Name
NUV100-SC	High-Voltage Stack Controller
NUV100-SC-NC	High-Voltage Stack Controller, no CAN
NUV100-PI-HE	High-Voltage Power Interface
NUV100-CI-12-1	G4 Cell Interface - 12 channel
NUV100-CI-16-1	G4 Cell Interface - 16 channel
NUV100-CI-4M12-1	G4 Cell Interface - 12V 4 channel

Figure 1. Nuvation Energy G4 High-Voltage BMS Modules

Generally, a single G4 High-Voltage BMS system uses one Stack Controller, one Power Interface, and one or more G4 Cell Interface modules. An example configuration is shown in Figure 2, “Nuvation Energy G4 High-Voltage BMS System Overview”

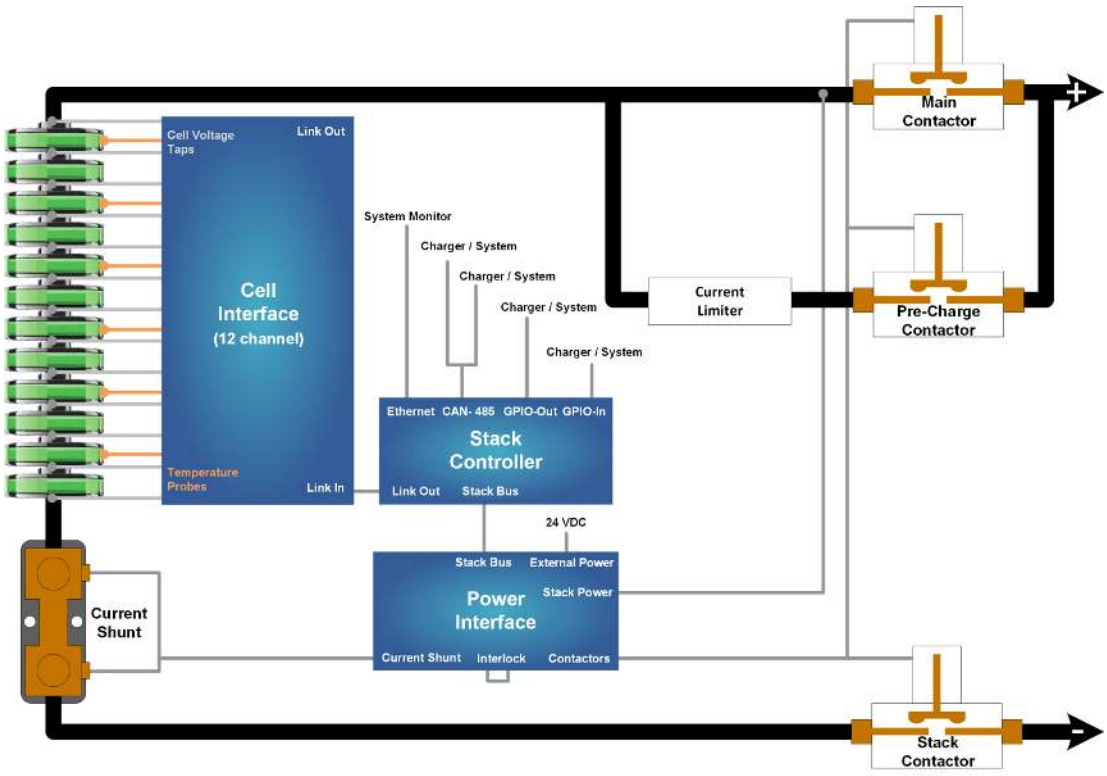

Figure 2. Nuvation Energy G4 High-Voltage BMS System Overview

1.1. High-Voltage Stack Controller

The High-Voltage Stack Controller contains the central MCU which handles all the processes and decision making required by Nuvation Energy G4 High-Voltage BMS. It monitors and controls all G4 Cell Interface modules in a single battery stack.

There are two variants of the Stack Controller; the NUV100-SC — Stack Controller and the NUV100-SC-NC — Stack Controller, no CAN.

Figure 3. Nuvation Energy High-Voltage Stack Controller Module

The external interfaces to this module are:

- 10/100 Base-T Ethernet RJ45 jack (Modbus-TCP)
- Isolated CAN 2.0 port (not available in no-CAN variants (*-NC))
- RS-485 (Modbus-RTU) connector
- 4 opto-isolated digital outputs
- 4 digital inputs
- Link Bus connector
- Stack Bus connector
- USB connector
- 3 Indicator LEDs

The Stack Controller does not have high-voltage connectors and does not connect to any battery stack referenced signals, making it safe to handle and connect to external equipment.

1.2. High-Voltage Power Interface

The High-Voltage Power Interface connects directly to high-voltage and high-current components. It accepts an external power input, provides power conditioning for all Nuvation Energy BMS modules and power for the contactors. The Stack Controller controls all operations on the Power Interface via the Stack Bus. The Power Interface contains a redundant MCU which handles all the processes and decision-making required by Nuvation Energy BMS to control the high-current contactors.

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

There is only one model of the Power Interface, the NUV100-PI-HE.

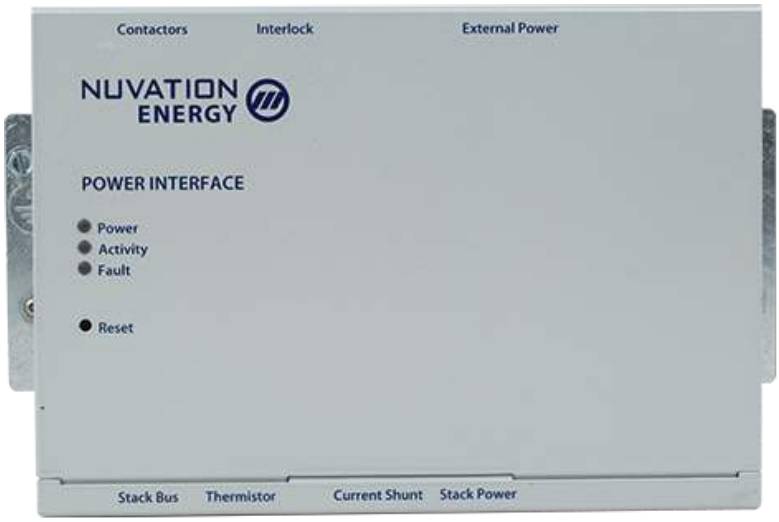

Figure 4. Nuvation Energy High-Voltage Power Interface Module

The external interfaces to this module are:

- 4 high-current contactor coil drivers
- Interlock input
- External Power input
- Stack Voltage input
- Current Shunt input
- Stack Bus connector
- Thermistor input
- 3 Indicator LEDs
- Reset push-button

1.3. G4 Cell Interface

The Nuvation Energy G4 Cell Interface is the direct link between the individual battery stack cells and the rest of the Battery Management System. It facilitates battery monitoring and balancing functionalities.

In a G4 High-Voltage BMS, one or more G4 Cell Interface modules are used to convert and relay cell voltage and temperature measurements digitally to the Stack Controller. When using multiple G4 Cell Interface modules, the same G4 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. The firmware does not support a mixed chain of different Cell Interface variants.

For systems that require UL 1973 compliance, the G4 Cell Interface supports up to 7 temperature sensors. For systems that do not require UL 1973 compliance, the G4 Cell Interface can support up to 8 temperature sensors.

The following are variants of the Nuvation Energy G4 Cell Interface:

- The NUV100-CI-12-1, G4 Cell Interface - 12 channel can monitor up to 12 series-connected cells
- The NUV100-CI-16-1, G4 Cell Interface - 16 channel can monitor up to 16 series-connected cells
- The NUV100-CI-4M12-1, G4 Cell Interface - 12V 4 channel can monitor up to 4 series-connected 12V lead-acid cells. Note that cell balancing is not supported in G4 Cell Interface - 12V 4 channel.

Figure 5. Nuvation Energy G4 Cell Interface Module

The external interfaces to this module are:

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

The G4 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.

1.4. G4 BMS Software

The Nuvation Energy G4 BMS Software is composed of two parts: the Operator Interface and the G4 BMS Firmware.

1.4.1. Operator Interface

Figure 6. Operator Interface Dashboard

The Operator Interface is a browser-based graphical view of the system state, data, and configuration.

Key Features

- **Provides Unified View of Entire Battery** - Access diagnostics and performance data of the battery stack
- **Statistics** - Provides stack-level voltage, temperature & current statistics for all cells
- **Real-Time** - Streams measurements and control signals for real-time display and recording
- **Faults and Warnings** - Aggregated for system-wide overview, plus detail drill-down for battery pack diagnostics
- **SOC and SOH** - Calculates State of Charge (SoC) and State of Health (SoH) for the battery stack
- **Communications Status** - Ensures that measurements, control signals, and other data are propagating properly throughout the entire system for safe operation
- **Flow-Through I/O** - Provides a single entry point to all measurement and control points in the BMS

1.4.2. G4 BMS Firmware

The G4 BMS Firmware is a highly configurable software that manages the stack operation and

controls. It enables the BMS to be used as a protection device against unsafe voltage, temperature, and current conditions in battery systems.

Key Features

- **Configuration Registers** - Numerous configuration options, called 'registers', to tune the G4 High-Voltage BMS for the specific end-application.
- **Functional Safety** - Functional safety according to UL 1998 specification is accomplished through several key capabilities of the software.
  - **Protection Functions** - Provides protection functions for a battery against hazardous voltage, temperature, and current conditions.
  - **Sensor Fault Detection** - Detects sensor faults in cell voltage, temperature, stack voltage, and stack current.
  - **Shorted Shunt Detection**- Detects short circuit failures, and wiring defects.
- **Under Voltage Lockout** - A safety feature to protect a battery from further damage when either cell/stack voltages are critically low.

2. Operating Limits

2.1. High-Voltage Stack Controller

Exceeding the maximum ratings will damage the Stack Controller module.

2.1.1. Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
		Stack Bus Specifications				
+VSYS	Input Voltage	Supplied by Power Interface	5.6	24	34	V DC
	Input Current	+VSYS = 24 V DC	0.042	-	1.3	A DC
Rterm	Termination resistance tolerance	-	118.8	120	121.2	Ω
	Power rating	-	-	-	0.125	W
StackbusP	Dominant Output	-	2.45	-	3.3	V DC
	Recessive Output	-	-	2.3	-	V DC
	Output Current	-	10	-	50	mA DC
	Output Signal Rise Time	-	35	-	135	ns
	Output Signal Fall Time	-	35	-	135	ns
StackbusN	Dominant Output	-	0.5	-	1.25	V DC
	Recessive Output	-	-	2.3	-	V DC
	Output Current	-	10	-	50	mA DC
	Output Signal Rise Time	-	35	-	135	ns
	Output Signal Fall Time	-	35	-	135	ns
		Link Bus Specifications				
+VBUS	Output Voltage	-	-	+VSYS	-	V DC
	Output Current	+VBUS = 24 V DC	-	-	1.26	A DC
IP_LINK	Output Current	-	-	-	20	mA DC
IN_LINK	Output Current	-	-	-	20	mA DC
		USB Specifications				
+5V_USB	USB Current	-	-	-	500	mA DC
+5V_USB	USB Voltage	-	-	5	-	V DC
		Ethernet Specifications				
ETH_Protocol	Ethernet data speeds	-	10	-	100	Base-T
ETH_Connector	Ethernet jack rating	-	-	Cat5e	-	
		GPIO-Out Specifications				

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Vmax	Open Blocking Voltage	Between *_A and *_B, or between *_B and *_A	-	-	60	V DC
Imax	Closed Maximum Current	Between *_A and *_B, or between *_B and *_A	-	-	400	mA DC
Ron	Closed-State Resistance	Between *_A and *_B, or between *_B and *_A	-	-	2	Ω
GPIO-In Specifications						
Turn-On	Turn On Threshold Voltage	-	0	-	1.4	V DC
	Turn-On Threshold Current	-	1.6	-	-	mA DC
Turn-Off	Turn-Off Threshold Voltage	-	3	-	5	V DC
	Turn-Off Threshold Current	-	-	1	-	mA DC
Vmax	Off Voltage	Iin = 0 mA	-	-	5	V DC
Imax	On Current	Vin = 0 V	-	-	12	mA DC
CAN Specifications (not available in no-CAN variants (*-NC))						
+VCAN	Input Voltage	-	5.5	12	-	V DC
	Input Current	+VCAN = 12 V DC	-	52	73	mA DC
Rterm	Termination resistance tolerance	-	118.8	120	121.2	Ω
	Power rating	-	-	-	0.125	W
CAN_P	Dominant Output	-	2.9	3.5	4.5	V DC
	Recessive Output	-	2	2.3	3	V DC
	Output Current	-	10	-	70	mA DC
	Output Signal Rise Time	-	-	20	50	ns
	Output Signal Fall Time	-	-	20	50	ns
CAN_N	Dominant Output	-	0.8	1.2	1.5	V DC
	Recessive Output	-	2	2.3	3	V DC
	Output Current	-	10	-	70	mA DC
	Output Signal Rise Time	-	-	20	50	ns
	Output Signal Fall Time	-	-	20	50	ns
Isolation	Rated Isolation	-	-	-	60	V
RS-485 Modbus-RTU Specifications						
+VMOD	Output Voltage	-	-	+VSYS	-	V DC
	Output Current	+VMOD = 24 V DC	-	-	1	A DC
Rterm	Termination resistance tolerance	-	148.5	150	151.5	Ω
	Power rating	-	-	-	0.125	W
|Vod|	Driver differential output	-	1.5	2	-	V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Io	Output current	-	-60	-	60	mA
tr	Output Signal Rise Time	-	0.3	0.7	1.2	µs
tf	Output Signal Fall Time	-	0.3	0.7	1.2	µs

2.1.2. Environmental Conditions

Symbol	Parameter	Min	Typ	Max	Units
	Thermal Specifications				
T_a	Operating Temperature	-10	25	60	°C
	Storage Temperature	-20	25	60	°C
	Humidity Specifications				
RH	Operational RH	5	-	85	%
	Storage RH	5	-	85	%
	Shock and Vibration Specifications				
Vertical	Vertical shock/vibration	-	-	10	m/s^2
Longitudinal	Longitudinal shock/vibration	-	-	10	m/s^2
Transverse	Transverse shock/vibration	-	-	10	m/s^2
Pulse vibration	On each axis	-	-	245	m/s^2
	Altitude Specifications				
A_a	Operating Altitude	-	-	2000	m

The Stack Controller meets industry standards CISPR 22 Class A and IEC/EN 61000-4-2 for EMC/EMI and ESD respectively. All components are EU RoHS / China RoHS compliant.

The Stack Controller has been designed to meet the requirements of SAE J2464 (shock) and SAE J2380 (random vibration).

2.1.3. Standards and Certifications

The Stack Controller meets industry standards CISPR 22 Class A and IEC/EN 61000-4-2 for EMC/EMI and ESD respectively. All components are EU RoHS / China RoHS compliant.

Standard/Certification		
Stationary Battery Safety	UL Recognized	UL 1973 (file no. MH64071)
Functional Safety	UL Recognized	UL 991 (file no. MH64071) UL 1998 (file no. MH64071)

UL 1973 recognition ensures safe battery operation and significantly reduces the effort of certifying the energy storage solution to meet UL 1973 and UL 9540.

2.2. High-Voltage Power Interface

Exceeding the maximum ratings will damage the Power Interface module.

2.2.1. Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
External Power Specifications						
+VIN	Input DC Voltage	-	13	24	34	V DC
	Input AC Voltage	-	16	20	24	V AC
	Input DC Current	+VIN = 24 V DC	-	-	3.5	A DC
	Input AC Current	+VIN = 24 V AC	-	-	5.5	A AC
	Input Isolation from Chassis/COM	-	60	-	-	V RMS
Stack Power Specifications						
+VSPIN	Input DC Voltage	-	0	-	1250	V DC
	Input DC Current	+VSPIN = 1250 V DC	-	-	313	µA DC
Vins	Internal reinforced insulation rating from Chassis/COM	-	-	-	1250	V DC
Stack Bus Specifications						
+VSYS	Output Voltage	-	13	24	34	V DC
	Output Current	+VSYS = 24 V DC	-	-	1.3	A DC
Rterm	Termination resistance tolerance	-	118.8	120	121.2	Ω
	Power rating	-	-	-	0.125	W
StackbusP	Dominant Output	-	2.45	-	3.3	V DC
	Recessive Output	-	-	2.3	-	V DC
	Output Current	-	10	-	50	mA DC
	Output Signal Rise Time	-	35	-	135	ns
	Output Signal Fall Time	-	35	-	135	ns
StackbusN	Dominant Output	-	0.5	-	1.25	V DC
	Recessive Output	-	-	2.3	-	V DC
	Output Current	-	10	-	50	mA DC
	Output Signal Rise Time	-	35	-	135	ns
	Output Signal Fall Time	-	35	-	135	ns
Contactors Specifications						

Symbol	Parameter	Conditions	Min	Typ	Max	Units
+VCOIL	External Coil Power Supply Input	-	5	24	40	V DC
	External Coil Power Supply Continuous Current	+VCOIL = 24 V DC	-	-	2.8	A DC
	External Coil Power Supply Pulse Current (<300 µs)	+VCOIL = 24 V DC	-	-	20	A DC
+VINT	Internal Coil Power Supply Voltage	-	-	+VSYS	-	V DC
	Internal Coil Power Supply Current	-	-	-	2.8	A DC
COIL(n)	Coil Driver Output Voltage	-	-	+VCOIL	-	V DC
	Coil Driver Output Current	+VCOIL = 24 V DC	-	-	2.8	A DC
Interlock Specifications						
OVERRIDE	OverRide Voltage Output	+VCOIL = 24 V DC	-	5	-	V DC
	OverRide Current Output	+VCOIL = 24 V DC	49.5	50	50.5	mA DC
DRV	Drv Voltage Output	+VCOIL = 24 V DC	-	5	-	V DC
	Drv Current Output	+VCOIL = 24 V DC	49.5	50	50.5	mA DC
Current Shunt Specifications						
VSHUNT_REF	Reference Output Voltage	-	-	1.25	-	V DC
	Reference Output Current	-	-250	0	250	µA DC
Vdiff	Differential voltage between VSHUNT_BAT and VSHUNT_LOAD	-	-1	0	1	V DC
Vmes	Measurement resolution	-	-	143	-	nV DC
Vins	Internal reinforced insulation rating from Chassis/COM	-	-	-	1250	V DC
Thermistor Specifications						
+VTHERM	Thermistor Output Voltage	-	-	2.5	-	V DC
	Thermistor Output Current	+VTHERM = 2.5 V DC	-	-	250	µA
Rt	Thermistor Resistance at 25 °C	-	-	10	-	kΩ
Vins	Internal reinforced insulation rating from Chassis/COM	-	-	-	1250	V DC

While G4 High-Voltage BMS is UL-approved for use with +VSYS voltages down to 13 V DC, operation beyond the certified range is possible down to 10.6 V DC.

2.2.2. Environmental Conditions

Symbol	Parameter	Min	Typ	Max	Units
	Thermal Specifications				
T_a	Operating Temperature	-10	25	60	°C
	Storage Temperature	-20	25	60	°C
	Humidity Specifications				
RH	Operational RH	5	-	85	%
	Storage RH	5	-	85	%
	Shock and Vibration Specifications				
Vertical	Vertical shock/vibration	-	-	10	m/s^2
Longitudinal	Longitudinal shock/vibration	-	-	10	m/s^2
Transverse	Transverse shock/vibration	-	-	10	m/s^2
Pulse vibration	On each axis	-	-	245	m/s^2
	Altitude Specifications				
A_a	Operating Altitude	-	-	2000	m

The Power Interface has been designed to meet the requirements of SAE J2464 (shock) and SAE J2380 (random vibration).

2.2.3. Standards and Certifications

The Power Interface meets industry standards CISPR 22 Class A and IEC/EN 61000-4-2 for EMC/EMI and ESD respectively. It has been designed to meet EN 60950 high voltage creepage/clearance distances for reinforced insulation rated to 1250 V DC. All components are EU RoHS / China RoHS compliant.

Standard/Certification		
Stationary Battery Safety	UL Recognized	UL 1973 (file no. MH64071)
Functional Safety	UL Recognized	UL 991 (file no. MH64071) UL 1998 (file no. MH64071)

UL 1973 recognition ensures safe battery operation and significantly reduces the effort of certifying the energy storage solution to meet UL 1973 and UL 9540.

2.3. G4 Cell Interface

Exceeding the maximum ratings will damage the G4 Cell Interface module.

2.3.1. Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
		Link In Specifications				
$+V_{BUS}$	Input Voltage	-	9	24	60	V DC
	Input Current, CI-12	+VBUS = 24 V DC, Link Out disconnected	-	-	25.5	mA DC
	Input Current, CI-16 and CI-4M12	+VBUS = 24 V DC, Link Out disconnected	-	-	31.7	mA DC
I_{P_LINK}	Output Current	-	-	-	20	mA DC
I_{N_LINK}	Output Current	-	-	-	20	mA DC
		Link Out Specifications				
$+V_{BUS}$	Output Voltage	-	-	+VBUS	-	V DC
	Output Current per CI-12	+VBUS = 24 V DC	-	-	25.5	mA DC
	Output Current per CI-16 and CI-4M12	+VBUS = 24 V DC	-	-	31.7	mA DC
I_{P_LINK}	Output Current	-	-	-	20	mA DC
I_{N_LINK}	Output Current	-	-	-	20	mA DC
		Battery Cells Specifications				
$C_{(n)}$ - $C_{(n-1)}$	Input Cell Voltage Range	CI-12, CI-16	0	-	5	V DC
$B_{(n)}$ - $B_{(n-1)}$	Input Block Voltage Range	CI-4M12	5	-	20	V DC
V_{sum}	Voltage between C0 and C12	CI-12, +VBUS = 0 V DC	11	-	60	V DC
	Voltage between C0 and C8	CI-16, +VBUS = 0 V DC	11	-	40	V DC
	Voltage between C8 and C16	CI-16, +VBUS = 0 V DC	11	-	40	V DC
	Voltage between B0 and B2	CI-4M12, +VBUS = 0 V DC	11	-	40	V DC
	Voltage between B2 and B4	CI-4M12, +VBUS = 0 V DC	11	-	40	V DC
TME	Total Measurement Error	CI-12, CI-16, +VBUS = 24 V DC	±0.1	±1.2	±1.6	mV DC
	Total Measurement Error	CI-4M12, +VBUS = 24 V DC	±2.0	±8.0	±10.0	mV DC
$I_{(n)}$	Cell Balancing Current (only for CI-12 and CI-16)	C(n) - C(n-1) = 4 V DC	304	307	310	mA DC
V_{bal}	Cell Voltage for Balancing	CI-12 and CI-16	1.1	-	-	V DC

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{ins}	Internal reinforced insulation rating from Chassis/COM	-	-	-	1250	V DC
CAT_{II}	Overvoltage category	Phase to Ground Rated System Voltage (RMS or DC)	-	-	300	V
CAT_{III}	Overvoltage category	Phase to Ground Rated System Voltage (RMS or DC)	-	-	150	V
Temperature Sensors Specifications						
$I_{(n)}$	Output Current to Temperature Sensor	-	-	-	300	µA
$R_{t(n)}$	Temperature Sensor Resistance at 25 °C	-	-	10	-	kΩ
$T_{(n)}$	Input Temperature Sensor Voltage Range	Cell 0 or Block 0 = 0 V	0	-	3	V
V_{ins}	Internal reinforced insulation rating from Chassis/COM	-	-	-	1250	V DC
CAT_{II}	Overvoltage category	Phase to Ground Rated System Voltage (RMS or DC)	-	-	300	V
CAT_{III}	Overvoltage category	Phase to Ground Rated System Voltage (RMS or DC)	-	-	150	V

2.3.2. Environmental Conditions

Symbol	Parameter	Min	Typ	Max	Units
Thermal Specifications					
T_a	Operating Temperature	-10	25	60	°C
	Storage Temperature	-20	25	60	°C
Humidity Specifications					
RH	Operational RH	5	-	85	%
	Storage RH	5	-	85	%
Shock and Vibration Specifications					
Vertical	Vertical shock/vibration	-	-	10	m/s^2
Longitudinal	Longitudinal shock/vibration	-	-	10	m/s^2
Transverse	Transverse shock/vibration	-	-	10	m/s^2
Pulse vibration	On each axis	-	-	245	m/s^2
Altitude Specifications					
A_a	Operating Altitude	-	-	2000	m

2.3.3. Standards and Certifications

The G4 Cell Interface meets industry standards CISPR 22 Class A and IEC/EN 61000-4-2 for EMC/EMI and ESD respectively. It has been designed to meet EN 60950 high voltage creepage/clearance distances for reinforced insulation rated to 1250 V DC. All components are EU RoHS / China RoHS compliant.

Certification/Report	
Stationary Battery Safety	UL Recognized - UL 1973 (file no. MH64071)
Functional Safety	- UL Recognized - UL 991 (file no. MH64071) - UL Recognized - UL 1998 (file no. MH64071)
Electrical Safety	IEC 62368-1:2014 (Second Edition), IEC 62368-3:2017
Industrial Immunity	EN/IEC 61000-6-2 2019
Shock and Vibration	Designed to meet the requirements of SAE J2464 and SAE J2380

UL 1973 recognition ensures safe battery operation and significantly reduces the effort of certifying the energy storage solution to meet UL 1973 and UL 9540.

2.3.4. Maximum Stack Deployment

G4 Cell Interface modules are deployed as a daisy chain to monitor the cells of a stack. The maximum number of modules that are supported in a stack are listed in Table 2, “Maximum G4 Cell Interface Chain Length”.

Table 2. Maximum G4 Cell Interface Chain Length

G4 Cell Interface Type	Maximum Chain Length
CI-12	40
CI-16	30
CI-4M12	30

2.3.4.1. Cell Voltage Scan Rate

The following are approximate cell voltage scan rates for different lengths of G4 Cell Interface daisy chains where all cells are installed. They are provided for reference only and can vary depending by functionality enabled on the Nuvation Energy BMS.

Table 3. Cell Voltage Scan Rates for CI-16 and CI-4M12

Measurement Anti-Aliasing Filter	G4 Cell Interface Chain Length	Scan Rate [Hz]
Off	1	5.53
Off	5	3.32
Off	10	2.22
Off	15	1.74
Off	20	1.38
Off	25	1.15

Measurement Anti-Aliasing Filter	G4 Cell Interface Chain Length	Scan Rate [Hz]
Off	30	0.91
On	1	1.55
On	5	1.31
On	10	1.11
On	15	0.98
On	20	0.84
On	25	0.76
On	30	0.63

Table 4. Cell Voltage Scan Rates for CI-12

Measurement Anti-Aliasing Filter	G4 Cell Interface Chain Length	Scan Rate [Hz]
Off	1	6.01
Off	5	3.94
Off	10	3.03
Off	15	2.59
Off	20	1.97
Off	25	1.63
Off	30	1.44
Off	35	1.30
Off	40	1.08
On	1	1.58
On	5	1.38
On	10	1.26
On	15	1.14
On	20	1.00
On	25	0.94
On	30	0.86
On	35	0.80
On	40	0.72

3. Mechanical Overview

3.1. High-Voltage Stack Controller

The overall dimensions of the Stack Controller are 104.4 mm × 121.58 mm × 40.6 mm. The Stack Controller weighs approximately 525 g.

Included with the Stack Controller are DIN clips that enable the Stack Controller to be securely mounted to EN50022-compliant DIN rails. The clips add an extra 19.6 mm to the overall width of the Stack Controller, bringing it from 104.4 mm to 124 mm. The clips also hold the module approximately 7 mm away from the inside lip of the DIN rail.

Extra space should be provided around the module to allow for sufficient heat dissipation, and cable installation.

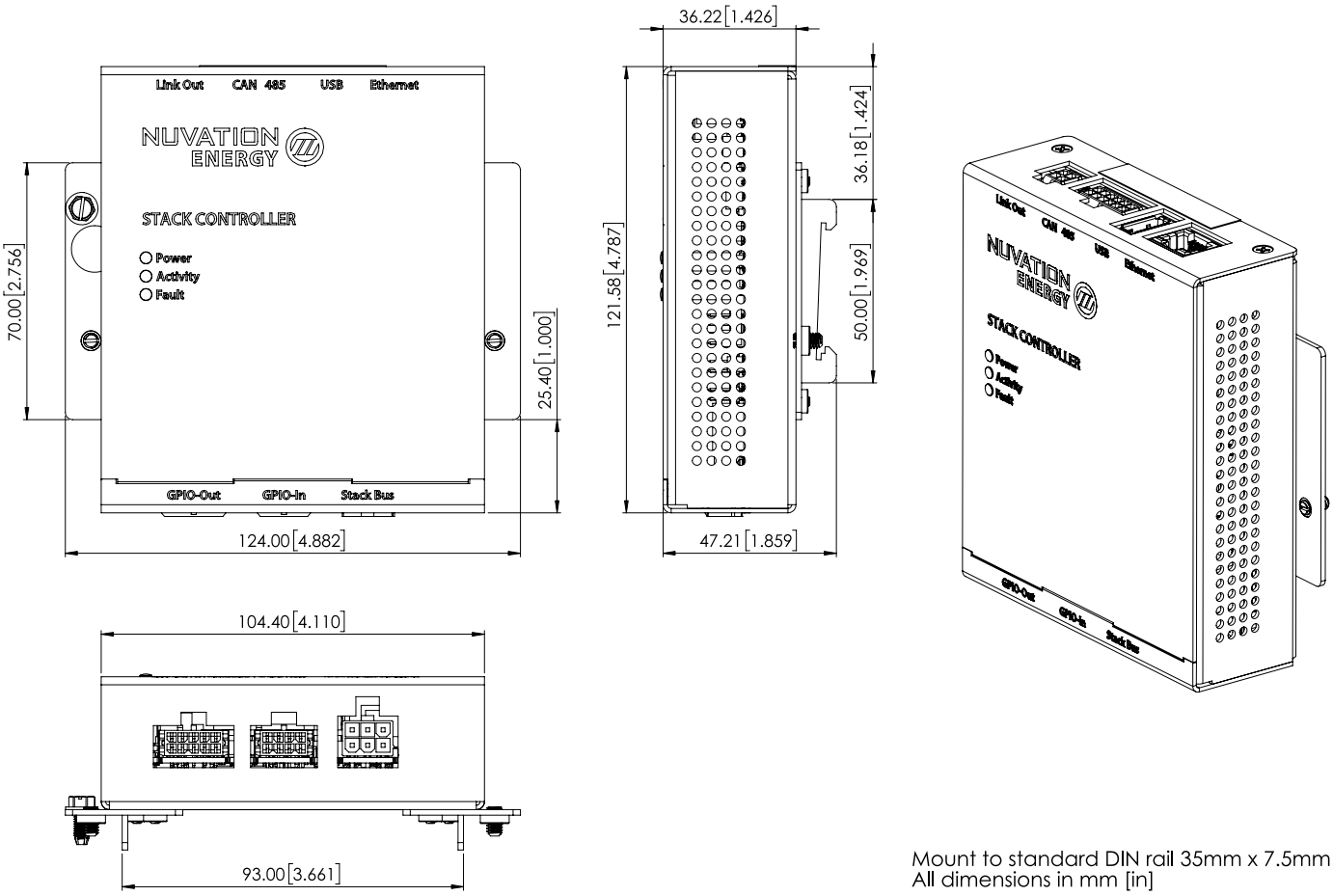

Figure 7. Mechanical Drawing of Stack Controller

3.2. High-Voltage Power Interface

The overall dimensions of the Power Interface are 174.40 mm × 121.58 mm × 48.60 mm. The Power Interface weighs approximately 915 g.

Included with the Power Interface are DIN clips that enable the Power Interface to be securely mounted to EN50022-compliant DIN rails. The clips add an extra 19.6 mm to the overall width of the Power Interface, bringing it from 174.40 mm to 194 mm. The clips also hold the module approximately 7 mm away from the inside lip of the DIN rail.

Extra space should be provided around the module to allow for sufficient heat dissipation, and cable installation.

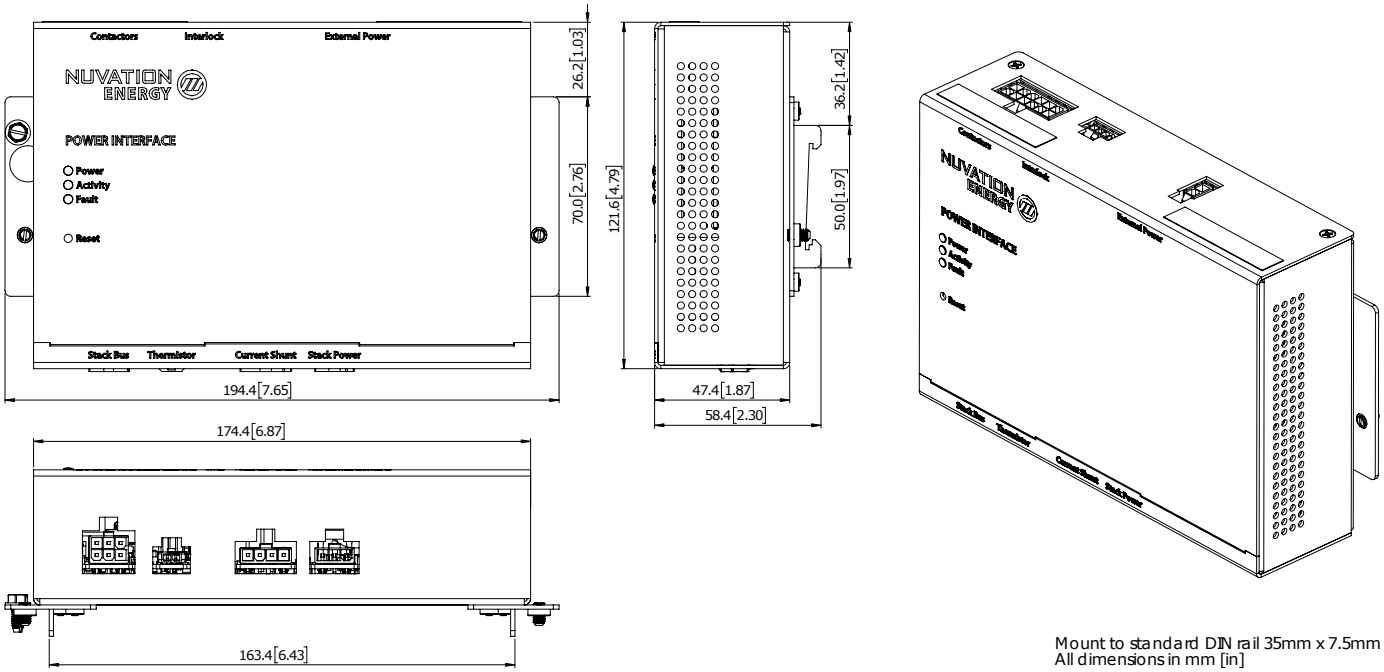

Figure 8. Mechanical Drawing of Power Interface

3.3. G4 Cell Interface

The overall dimensions of the G4 Cell Interface are 104.4 mm × 121.58 mm × 40.6 mm. The standard G4 Cell Interface (i.e. with bulkhead) weighs approximately 450 g.

The G4 Cell Interface is available in a bulkhead-mountable enclosure as shown in Figure 9, "Mechanical Drawing of G4 Cell Interface with Bulkhead Enclosure". The enclosure has five metal walls, leaving the back of the unit fully exposed.

It must be mounted to a metal bulkhead panel such that the panel covers the exposed back.

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 sufficient heat dissipation, and cable installation.

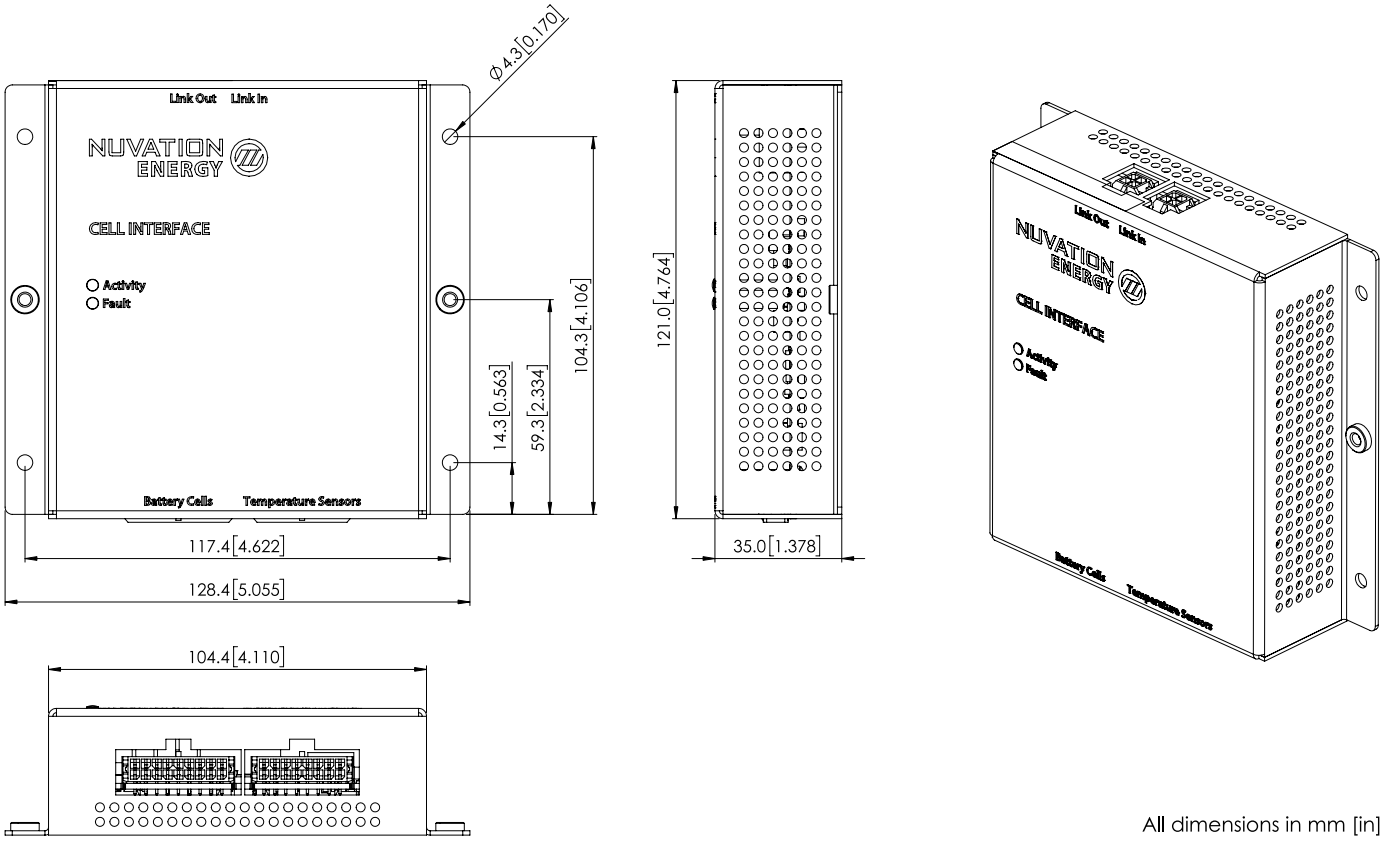

Figure 9. Mechanical Drawing of G4 Cell Interface with Bulkhead Enclosure

3.3.1. Optional DIN rail mounting Kit

For applications requiring DIN rail mounting, the G4 Cell Interface may be ordered with the G4 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 G4 Cell Interface (i.e. with bulkhead enclosure) to EN50022-compliant DIN rails, as shown in Figure 10, "Mechanical Drawing of

G4 Cell Interface with G4 Cell Interface Mounting Bracket (Bulkhead-to-DIN)".

The Mounting Bracket kit assembly adds an extra 14.2 mm to the overall width of the G4 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 G4 Cell Interface module from the center of the DIN rail approximately 30 mm upwards as shown in Figure 10, "Mechanical Drawing of G4 Cell Interface with G4 Cell Interface Mounting Bracket (Bulkhead-to-DIN)".

A G4 Cell Interface with the Mounting Bracket weighs approximately 540 g.

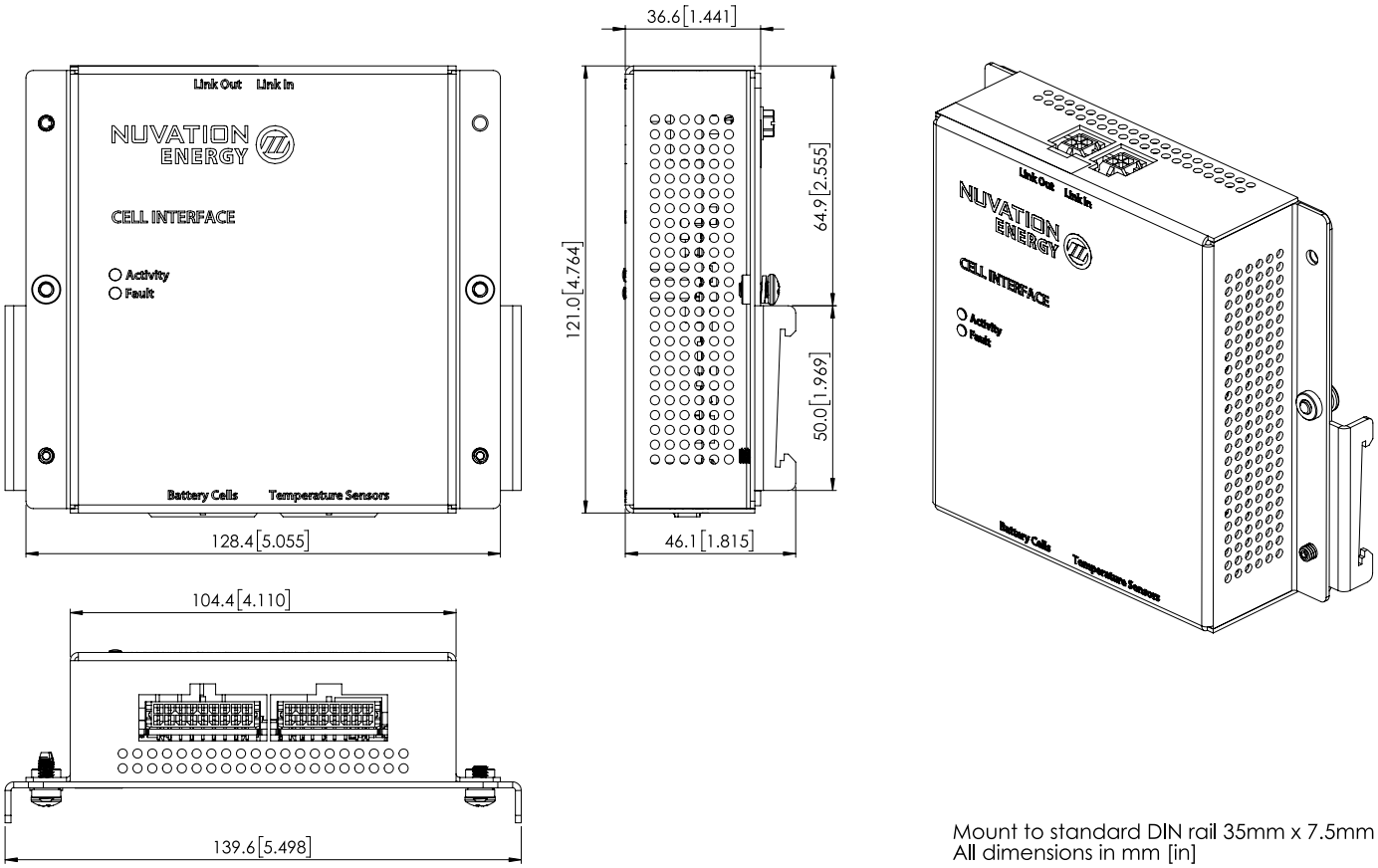

Figure 10. Mechanical Drawing of G4 Cell Interface with G4 Cell Interface Mounting Bracket (Bulkhead-to-DIN)

4. Ordering Information

G4 High-Voltage BMS kits—which include the modules, cables, and power supply—are available to get you started quickly. Please visit https://nstore.nuvationenergy.com for more details.

Table 5. G4 High-Voltage BMS Ordering Information (kits)

Part Number	Product Name
NUV100-BASE-NC-12-KIT	G4 High-Voltage BMS Kit - 12 channel, no CAN
NUV100-BASE-NC-16-KIT	G4 High-Voltage BMS Kit - 16 channel, no CAN
NUV100-BASE-NC-4M12-KIT	G4 High-Voltage BMS Kit - 12V 4 channel, no CAN
Available as special order	
NUV100-BASE-12-KIT	G4 High-Voltage BMS Kit - 12 channel
NUV100-BASE-16-KIT	G4 High-Voltage BMS Kit - 16 channel
NUV100-BASE-4M12-KIT	G4 High-Voltage BMS Kit - 12V 4 channel

4.1. High-Voltage Stack Controller

Product part numbers for ordering a Stack Controller are listed in Table 6, "Stack Controller Ordering Information".

Table 6. Stack Controller Ordering Information

Part Number	Product Name
NUV100-SC-NC	High-Voltage Stack Controller, no CAN, DIN Mount
NUV100-SC-NC-U	High-Voltage Stack Controller, no CAN, PCB assembly only (no enclosure)
Available as special order	
NUV100-SC	High-Voltage Stack Controller, DIN Mount
NUV100-SC-U	High-Voltage Stack Controller, PCB assembly only (no enclosure)

4.2. High-Voltage Power Interface

Product part numbers for ordering a Power Interface are listed in Table 7, "Power Interface Ordering Information".

Table 7. Power Interface Ordering Information

Part Number	Product Name
NUV100-PI-HE	High-Voltage Power Interface, DIN Mount

Part Number	Product Name
NUV100-PI-HE-U	High-Voltage Power Interface, PCB assembly only (no enclosure)

If mounting a `Power Interface, PCB assembly only (no enclosure)`, note that the Power 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.

4.3. G4 Cell Interface

Product part numbers for ordering a G4 Cell Interface are listed in Table 8, "G4 Cell Interface Ordering Information". Accessory kits are listed in Table 9, "G4 Cell Interface Accessory Kits Ordering Information".

G4 Cell Interface kits—which include the G4 Cell Interface module and cables—are available to get you started quickly. Please visit https://nstore.nuvationenergy.com for more details.

Table 8. G4 Cell Interface Ordering Information

Part Number	Product Name
NUV100-CI-12-1	G4 Cell Interface - 12 channel, Bulkhead
NUV100-CI-12-U	G4 Cell Interface - 12 channel, PCB assembly only (no enclosure)
NUV100-CI-12-KIT	G4 Cell Interface Kit - 12 channel
NUV100-CI-16-1	G4 Cell Interface - 16 channel, Bulkhead
NUV100-CI-16-U	G4 Cell Interface - 16 channel, PCB assembly only (no enclosure)
NUV100-CI-16-KIT	G4 Cell Interface Kit - 16 channel
NUV100-CI-4M12-1	G4 Cell Interface - 12V 4 channel, Bulkhead
NUV100-CI-4M12-U	G4 Cell Interface - 12V 4 channel, PCB assembly only (no enclosure)
NUV100-CI-4M12-KIT	G4 Cell Interface Kit - 12V 4 channel

If mounting a `G4 Cell Interface, PCB assembly only (no enclosure)`, note that the G4 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.

Table 9. G4 Cell Interface Accessory Kits Ordering Information

Part Number	Product Name
NUVP-CI-DIN-MB	G4 Cell Interface Mounting Bracket (Bulkhead-to-DIN)

5. Document Revision History

Revision	Date	Details
2.4	2021-03-04	Initial Release
2.5	2021-08-13	Added details for High-Voltage Stack Controller, no CAN variant (*-NC)
2.6	2023-07-05	Updated UL Recognized status
3.0	2024-07-26	- Added software functional overview - Added Altitude specifications - Added specifications for Over-voltage Category - Clarified max stack deployment

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.