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NUV100-PI
Nuvation BMS™ Power Interface
Datasheet
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DISCLAIMER: From time to time Nuvation will make updates to Nuvation BMS™ in response to changes in available technologies, client requests, emerging energy storage standards and other industry requirements. The product specifications shown in this document therefore, are subject to change without notice.

Table of Contents

List of Tables

List of Figures

System Overview

Nuvation BMS™ is generally comprised of the following modules:

- 1 Stack Controller
- 1 Power Interface
- 1 or more Cell Interfaces

An example configuration is shown in Figure 1.

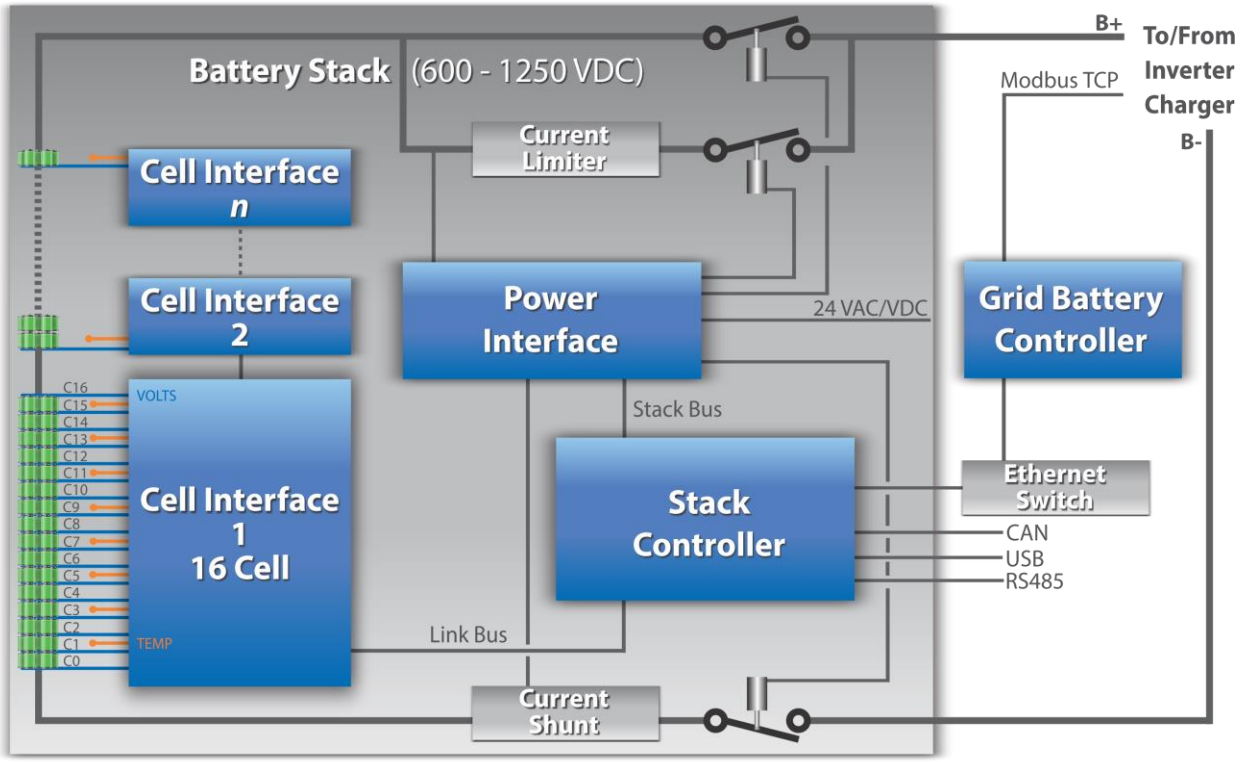

Figure 1: Nuvation BMS™ Example System Diagram

This datasheet addresses the Power Interface. Refer to the Stack Controller or Cell Interface datasheets for information about the other modules in Nuvation BMS™.

Hardware Overview

The Power Interface (PI) module contains a redundant MCU which handles all the processes and decision making required by Nuvation BMS™ to control the high-current contactors. The external interfaces to this module are:

- Four (4) high-current contactor coil drivers
- Nuvation BMS™ Interlock input
- Auxiliary Power input
- Stack Power input
- Current Shunt input
- Current Shunt thermistor input
- Stack Bus connector
- Three (3) Indicator LEDs
- Reset push-button

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

There are four variations of the PIs based on the Stack Power input voltage range. Models A and B share the same enclosure as do Models C and D.

Table 1: Power Interface Models

PI Model	Stack Power Input Voltage Range [VDC]		
A	30	–	120
B	70	–	280
C	160	–	640
D	370	–	1250

The following subsections describe the external interfaces in more detail. For wiring/pin-out information, please refer to the *Nuvation BMS Implementation Guidebook*.

Contactors

The Contactors connector is a 12-pin Mini-Fit® Jr. Molex connector. This interface is used to drive up to four (4) external contactor coils. Each output is capable of sourcing a maximum of 2.8A continuously. The sum of all four output currents cannot be more than 2.8A continuous if powering +VCOIL from an external power source. If powering +VCOIL from the provided +VINT power source, the sum of all four output currents cannot be more than 2.8A or 2.9A minus 31.7mA per Cell Interface connected in the system, whichever limit is lowest.

Interlock

The Interlock connector is a 3-pin Micro-Fit 3.0™ Molex connector. This interface is used as a means of selecting the high-current contactor behaviour.

Table 2: Interlock Options

Interlock Connection		Function
1 & 3	2 & 3	
open	open	System contactors are de-energized
open	closed	System contactors are controlled by BMS software, but de-energized if hardware-based fault signaling detects a fault
closed	open or closed (does not matter)	System contactors are controlled by BMS software; hardware-based fault signaling mechanism will not de-energise system contactors
Note: Pin 3 is electrically connected to chassis ground.		

Aux Power

The Aux Power connector is a 2-pin Mini-Fit® Jr. Molex connector. This interface is used to supply external power to Nuvation BMS™ in place of Stack Power. The external power supply must be isolated for the battery stack and chassis ground. The external supply can also be used if the battery stack voltage is expected to drop below the minimum Stack Power input voltage requirement.

When the external power is equal to or greater than 24Vdc or 17Vac, Nuvation BMS™ will run off the Aux Power input regardless of the Stack Power input voltage. When the external power is less than 23Vdc or 16Vac, Nuvation BMS™ will run off Stack Power and will seamlessly fold over to Aux Power if the Stack Power voltage drops below the minimum level.

Stack Power

The Stack Power connector is a 3-pin Mini-Fit® Jr. Molex connector. This interface is used to supply power to Nuvation BMS™ as well as provide an overall stack voltage measurement and ground fault detection.

Current Shunt

The Current Shunt connector is a 4-pin Mini-Fit® Jr. Molex connector. This interface is used to connect the current shunt to the PI as well as for Nuvation BMS™ power return and ground fault detection.

Thermistor

The Thermistor connector is a 2-pin Micro-Fit 3.0™ Molex connector. This interface is used to connect the 10kΩ NTC thermistor on the current shunt to the PI module. The thermistor must be electrical isolated from the battery stack.

Stack Bus

The Stack Bus connector is a 6-pin Mini-Fit® Jr. Molex connector. This interface is used to connect the PI to the Stack Controller. The PI supplies power to the Stack Controller via the Stack Bus.

Indicator LEDs

The three (3) LEDs are used by the PI to indicate health and functional status to the user. All LEDs are controlled by the redundant MCU. The Power LED indicates the MCU is operational, the Activity LED indicates the MCU is processing data and the Fault LED indicates a fault has occurred in Nuvation BMS™.

Reset Push-Button

The reset push-button will reset the redundant MCU as well as power off +VSYS which means that the Stack Controller will power reset. The button only needs to be held for 0.5s to issue the reset.

Operating Limits

This section states the operating limits of the Power Interface module.
WARNING: Exceeding the maximum ratings will damage the module.

Electrical Characteristics

Table 3: Electrical Characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Aux Power Specifications						
+VIN	Input DC Voltage		13	24	34	Vdc
	Input AC Voltage		9	16	24	Vac
	Input Current	+VIN = 24Vdc	-	-	3	A
	Input Isolation from Chassis/COM		60	-	-	Vrms
Stack Power Specification						
+VBAT	Input DC Voltage Model A		30	-	120	Vdc
	Input DC Voltage Model B		70	-	280	Vdc
	Input DC Voltage Model C		160	-	640	Vdc
	Input DC Voltage Model D		370	-	1250	Vdc
	Input Current	+VBAT = 150Vdc	-	-	580	mAdc
Stack Bus Specifications						
+VSYS	Output Voltage		13	24	34	Vdc
	Output Current	+VSYS = 24Vdc	-	-	1.3	Adc
Rterm	Termination resistance tolerance		118.8	120	121.2	Ω
	Power rating		-	-	0.125	W
StackbusP	Dominant Output		2.45	-	3.3	Vdc
	Recessive Output		-	2.3	-	Vdc
	Output Current		10	-	50	mAdc
	Output Signal Rise Time		35	-	135	ns
	Output Signal Fall Time		35	-	135	ns
StackbusN	Dominant Output		0.5	-	1.25	Vdc
	Recessive Output		-	2.3	-	Vdc
	Output Current		10	-	50	mAdc
	Output Signal Rise Time		35	-	135	ns
	Output Signal Fall Time		35	-	135	ns
Contactors Specification						
+VCOIL	External Coil Power Supply Input		5	24	48	Vdc
	External Coil Power Supply Continuous Current	+VCOIL = 24Vdc	-	-	2.8	Adc
	External Coil Power Supply	+VCOIL = 24Vdc	-	-	20	Adc

Symbol	Parameter	Conditions	Min	Typ	Max	Units
	Pulse Current (<300µs)					
+VINT	Internal Coil Power Supply Voltage		-	+VSYS	-	Vdc
	Internal Coil Power Supply Current		-	-	2.8	Adc
COIL(n)	Coil Driver Output Voltage		-	+VCOIL	-	Vdc
	Coil Driver Output Current	+VCOIL = 24Vdc	-	-	2.8	Adc
Interlock Specifications						
OVERRIDE	OverRide Voltage Output	+VCOIL = 24Vdc	-	5	-	Vdc
	OverRide Current Output	+VCOIL = 24Vdc	49.5	50	50.5	mAdc
DRV	Drv Voltage Output	+VCOIL = 24Vdc	-	5	-	Vdc
	Drv Current Output	+VCOIL = 24Vdc	49.5	50	50.5	mAdc
Current Shunt Specifications						
VSHUNT_REF	Reference Output Voltage		-	1.25	-	Vdc
	Reference Output Current		-250	0	250	µAdc
Vdiff	Differential voltage between VSHUNT_BAT and VSHUNT_LOAD		-1.0	0	1.0	Vdc
Vmes	Measurement resolution		-	143	-	nVdc
PS_COM	Stack Power supply return current	+VBAT = 150Vdc	-	-	580	mAdc
Thermistor Specifications						
+VTHERM	Thermistor Output Voltage		-	2.5	-	Vdc
	Thermistor Output Current	+VTHERM = 2.5Vdc	-	-	250	µA
Rt	Thermistor Resistance at 25°C		-	10	-	kΩ

Environmental Conditions

Table 4: Environmental Conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Thermal Specifications						
Ta	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

The PI has also met industry standards CISPR 22 Class A and IEC/EN 61000-4-2 for EMC/EMI and ESD respectively. The PI has been designed to meet EN 60950 high voltage creepage/clearance distances to prevent arching to the metal enclosure. All components are EU RoHS/China RoHS compliant.

Mechanical Overview

The PI model A and B use a difference enclosure than PI model C and D. The connector and LED locations are the same between the two enclosures referenced to the bottom left corner.

Model A/B

The overall dimensions of the PI Model A and Model B are 135.40mm X 121.58mm X 48.60mm. It comes standard with DIN clips that enable it to be securely mounted to EN50022-compliant DIN rails. The clips add an extra 20mm to the overall width of the PI module, bringing it from 135.40mm to 155.40mm. Extra space should be provided around the module to allow for easy installation/maintenance.

The PI Model A and Model B can contain high-voltage signals. It is possible to have signals 280Vdc away from earth ground. Care must be taken when mounting the PCB into a metal enclosure to ensure the metal walls remain the correct distance from the exposed conductor on the PCB. Using the 280Vdc as an example, the metal walls must be at least 1.4mm from the nearest exposed conductor and not touch the PCB or any component on the PCB, including the connector housings.

The PI model A/B weighs approximately 800g.

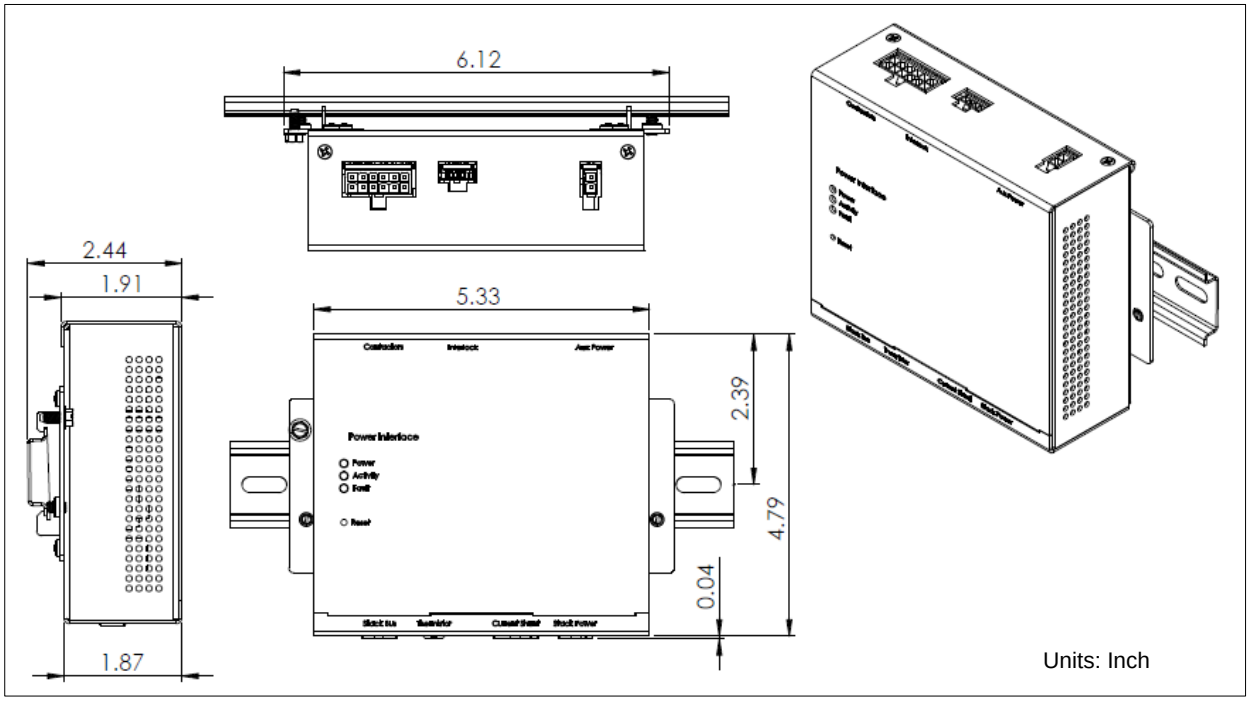

Figure 2: Mechanical Drawing Model A/B

The PI model A/B without the enclosure weighs approximately 178g.

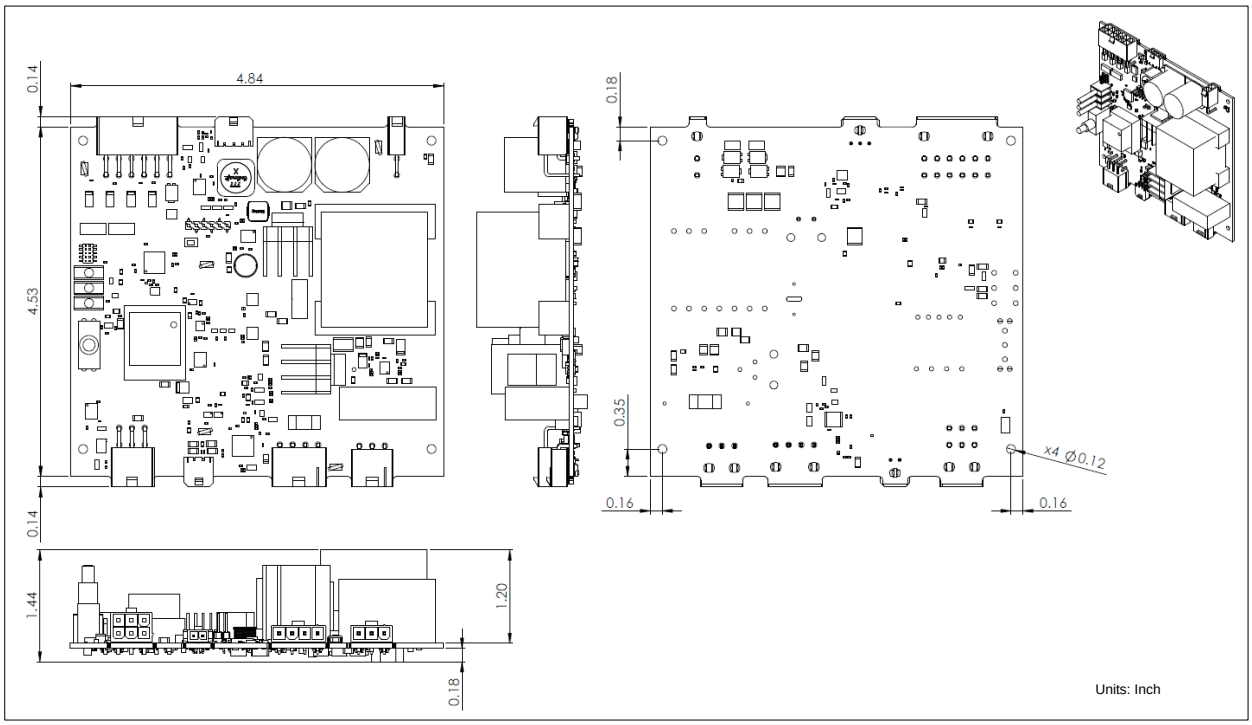

Figure 3: Mechanical Drawing of Model A/B PCB

Model C/D

The overall dimensions of the PI Model C and Model D are 174.40mm X 121.58mm X 48.60mm. It comes standard with DIN clips that enable it to be securely mounted to EN50022-compliant DIN rails. The clips add an extra 20mm to the overall width of the PI module, bringing it from 174.40mm to 194.40mm. Extra space should be provided around the module to allow for easy installation/maintenance.

The PI Model C and Model D can contain high-voltage signals. It is possible to have signals 1250Vdc away from earth ground. Care must be taken when mounting the PCB into a metal enclosure to ensure the metal walls remain the correct distance from the exposed conductor on the PCB. Using the 1250Vdc as an example, the metal walls must be at least 4.2mm from the nearest exposed conductor and not touch the PCB or any component on the PCB, including the connector housings.

The PI model C/D weighs approximately 1150g.

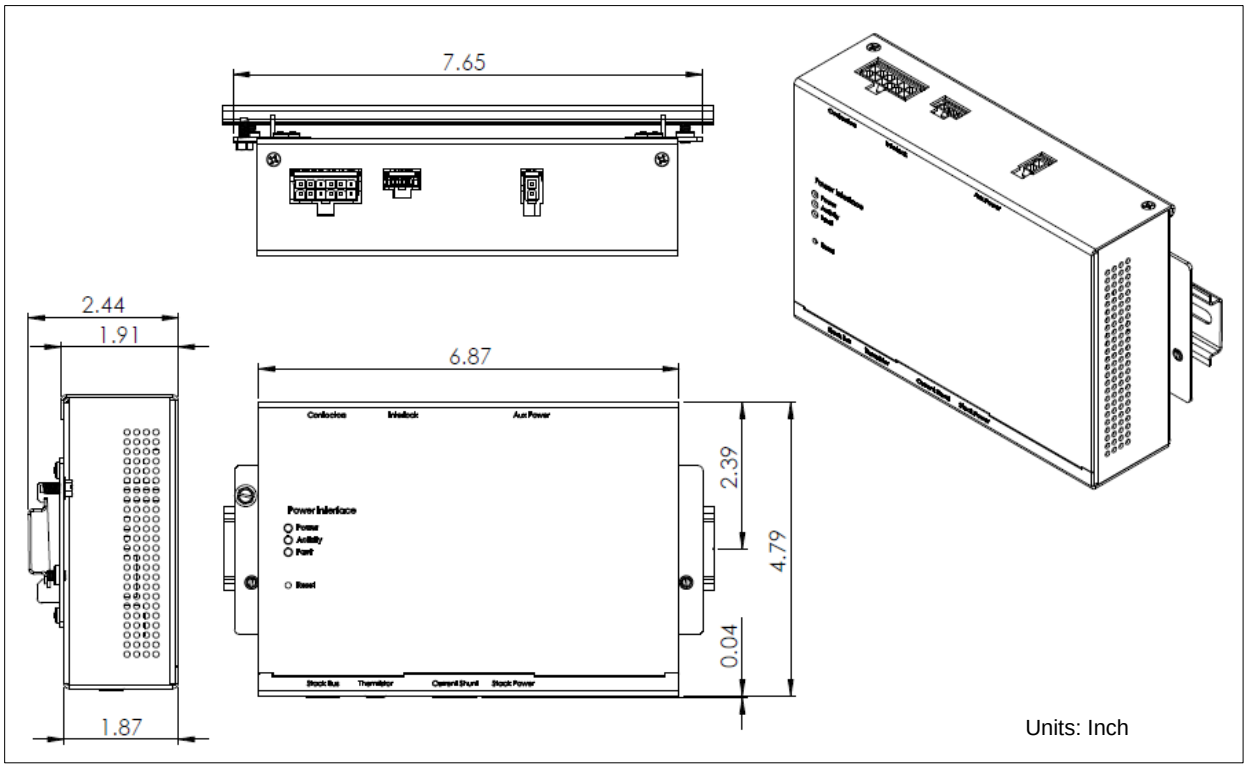

Figure 4: Mechanical Drawing Model C/D

The PI model C/D without the enclosure weighs approximately 300g.

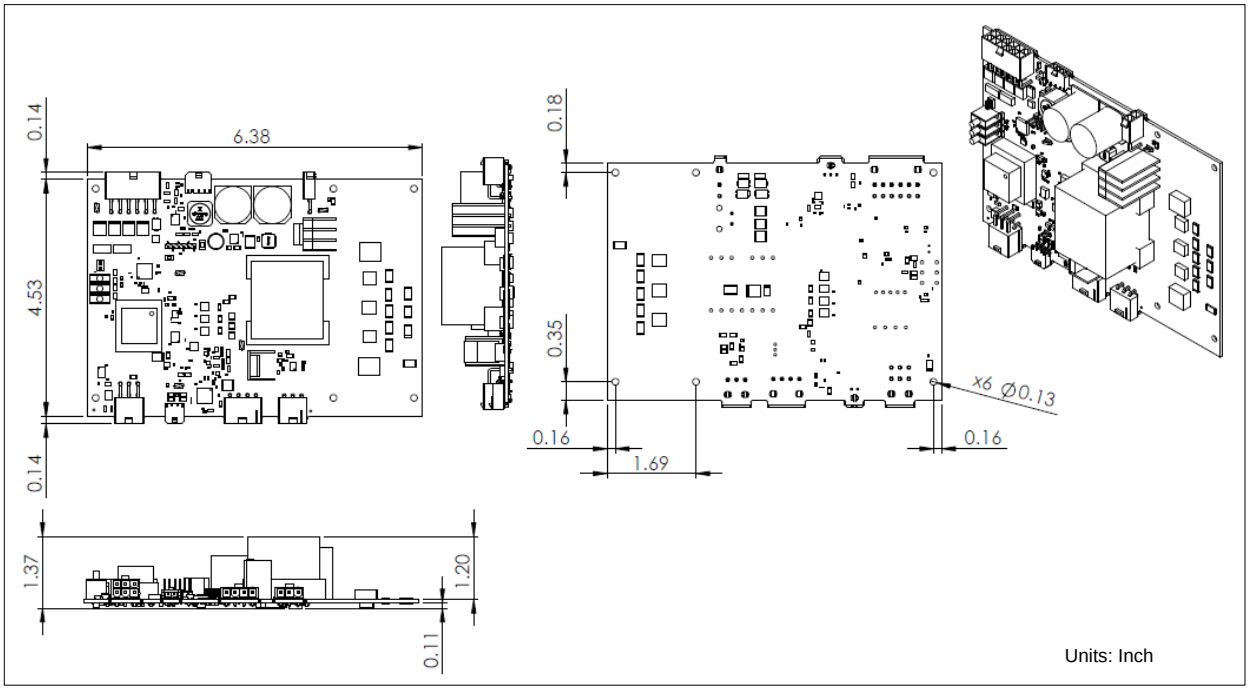

Figure 5: Mechanical Drawing of Model C/D PCB

Ordering Info

Model Number	Description
NUV100-PI-AE	Power Interface Model A External Power Only with Enclosure
NUV100-PI-AE-U	Power Interface Model A External Power Only PCB (no enclosure)
NUV100-PI-AS	Power Interface Model A Stack Powered with Enclosure
NUV100-PI-AS-U	Power Interface Model A Stack Powered PCB (no enclosure)
NUV100-PI-BE	Power Interface Model B External Power Only with Enclosure
NUV100-PI-BE-U	Power Interface Model B External Power Only PCB (no enclosure)
NUV100-PI-BS	Power Interface Model B Stack Powered with Enclosure
NUV100-PI-BE-U	Power Interface Model B Stack Powered PCB (no enclosure)
NUV100-PI-CE	Power Interface Model C External Power Only with Enclosure
NUV100-PI-CE-U	Power Interface Model C External Power Only PCB (no enclosure)
NUV100-PI-CS	Power Interface Model C Stack Powered with Enclosure
NUV100-PI-CS-U	Power Interface Model C Stack Powered PCB (no enclosure)
NUV100-PI-DE	Power Interface Model D External Power Only with Enclosure
NUV100-PI-DE-U	Power Interface Model D External Power Only PCB (no enclosure)
NUV100-PI-DS	Power Interface Model D Stack Powered with Enclosure
NUV100-PI-DS-U	Power Interface Model D Stack Powered PCB (no enclosure)

Notes:

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