



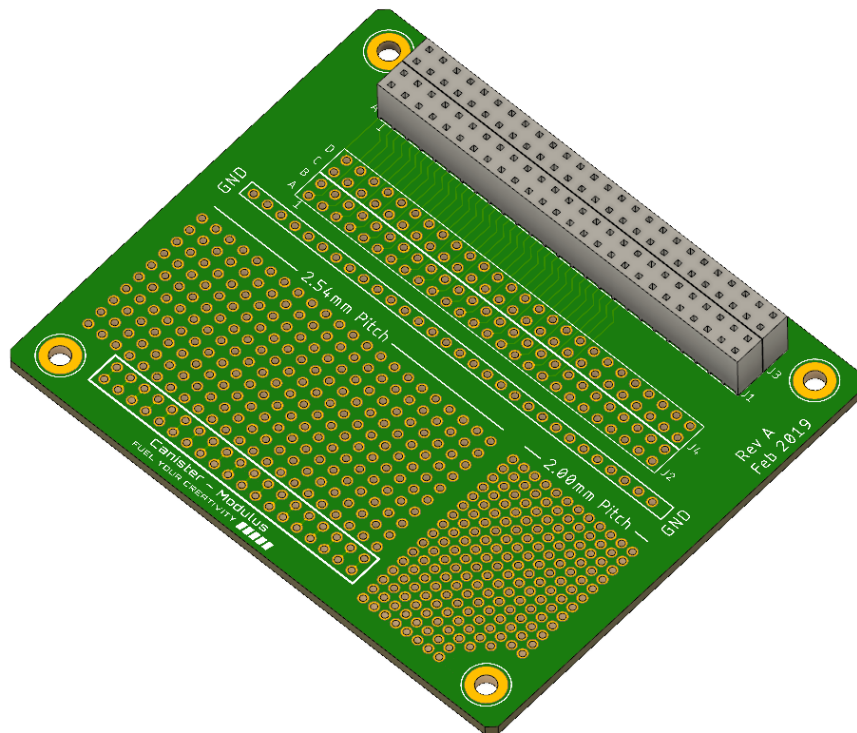
# ProteShea

Learn. Apply. Create.™

## Canister – Modulus™

ECCN (US): EAR99

# USER MANUAL



FUEL YOUR CREATIVITY ™

Use of this product or documentation signifies acceptance of the legal terms and conditions set forth below. Disagreement with any part of the legal terms and conditions set forth below permits the return of this product within 30-days of the date of purchase, per the terms described below.

Website: <https://proteshea.com>

Phone: 772-336-9761

**REVISION HISTORY**




<b>Date</b>	<b>Version</b>	<b>Revision</b>
4/15/2019	1.0	Initial release


## Table of Contents

SYMBOL DESCRIPTION	page 4
IMPORTANT INSTRUCTIONS & SAFETY	page 5
INTENDED USES	page 6
FEATURES	page 7
TECHNICAL SPECIFICATIONS	page 8
DESCRIPTION OF PRODUCT	page 9
HOW TO USE PRODUCT	page 10
INSTALLATION	page 16
REMOVAL	page 18
OPERATION	page 20
MAINTENANCE	page 21
TROUBLESHOOTING	page 21
INDEX	page 22
CONTACT INFORMATION	page 23
WARRANTY INFORMATION	page 24
LEGAL TERMS AND CONDITIONS	page 24

A. SYMBOL DESCRIPTION

Table 1. Symbol Description

Symbol	Warning Description
 ELECTRIC SHOCK WARNING	Symbol draws your attention to potential serious injury or death due to electric shock
 WARNING	Symbol draws your attention to potential serious or minor injury
 ESD CAUTION	Symbol draws your attention to notification that the device is sensitive to electro-static discharge (ESD). Handle electronics on an ESD workbench and wear proper protection and clothing to prevent accidental damage or loss of functionality.

 **WARNING:** To prevent injury, death, and/or damage to property while using this product, read this entire instruction manual.

**B. IMPORTANT INSTRUCTIONS & SAFETY**

WHEN USING THIS PRODUCT, BASIC PRECAUTIONS SHOULD ALWAYS BE FOLLOWED TO REDUCE THE RISK OF FIRE, ELECTRIC SHOCK, DAMAGE TO PROPERTY, AND/OR INJURY TO PERSONS, INCLUDING THE FOLLOWING:

1. Read all instructions before using the Canister.
2. Use the Canister only as described in this manual. Any other use not recommended by ProteShea may cause, without limitation, fire, electric shock, damage to property, and/or injury to persons.
3. Do not modify the Canister in any way that is not described in this user manual.
4. Do not use the Canister outdoors.
5. Do not operate the Canister after it malfunctions. Disconnect power at the main 5-pin DIN connector and unplug the AC/DC power supply from the AC source.
6. The Canister kits may contain small parts which pose a choking hazard, keep out of the reach of children less than 6 years of age.
7. When installing the Canister, see the **INSTALLATION** section for additional warnings and precautions.
8. For safe operation throughout the lifetime of this product, see the **MAINTENANCE** section.

### C. INTENDED USES

The Modulus™ Canister is designed for use with the FuelCan™ and other Canister models (Adapticon™) and can be stacked to provide the user's desired functionality. Numerous types of sensors and hardware can be soldered to Modulus that are compatible with the voltage rails provided by the FuelCan (+3.3V, +5.0V, +12.0V, and -12.0V).

Its intended users, 12+ years of age, include the following:

- Electronics hobbyists
- High school students interested in a STEM degree
- College students pursuing a STEM degree
- University researchers

Its intended use cases include the following:

- Raspberry Pi evaluation and development
- Electronics prototyping and evaluation
- Data acquisition system
- Motor control and automation
- Ground station
- Status display with LED and switch array (shown in Fig. 1)

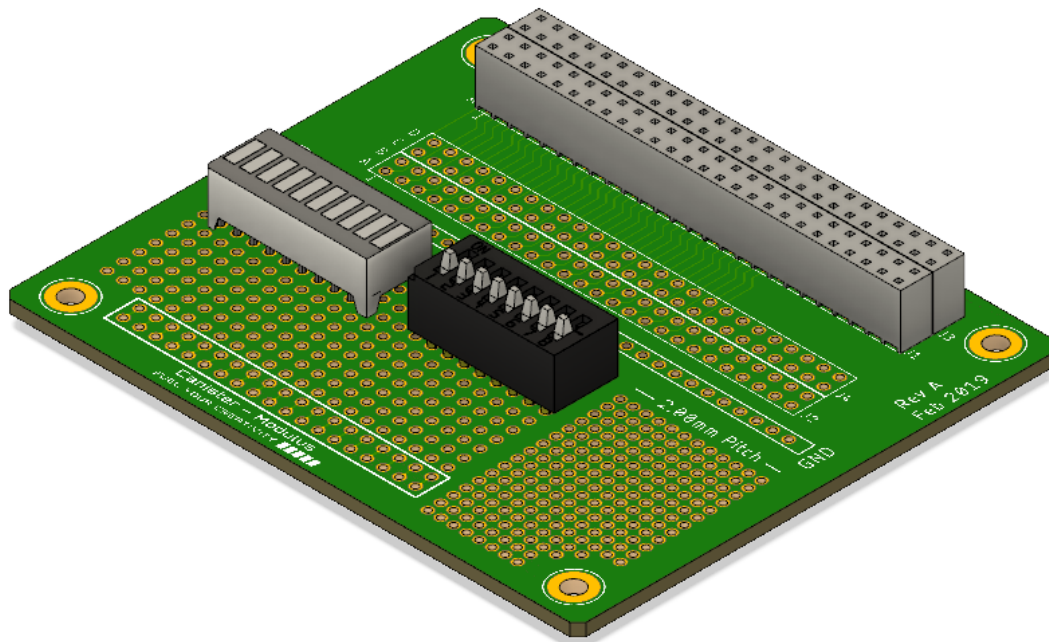


Figure 1. Intended Use Example.

## D. FEATURES

Canister-Modulus™ development board contains the following:

- 4x26-pin header compatible with FuelCan™ Main Interface board
- 4x26-pin header breakout for debug and test
- CubeSat form-factor
- 1-to-1 trace link for wire-wrap applications
- 2.54mm and 2.00mm prototype areas

## E. TECHNICAL SPECIFICATIONS

Table 2. Overview of Technical Specification

Model	Canister – Modulus™
Mass	36 grams
Dimensions	3.05" x 3.55"
Max current rating of connector	5.7A
Operating Temperature	-55°C to 125°C



**WARNING:** To prevent risk of fire or damage, do not exceed maximum current or power ratings of the FuelCan's provided AC-DC adaptor.



**WARNING:** Combined current rating for the +5.0V and +3.3V supplies is 2.5A. Potential risk of fire, damage, or injury if this rating is exceeded. Ensure that these limits are not exceeded across the entire application including development board and full Canister board stack.



F. DESCRIPTION OF PRODUCT

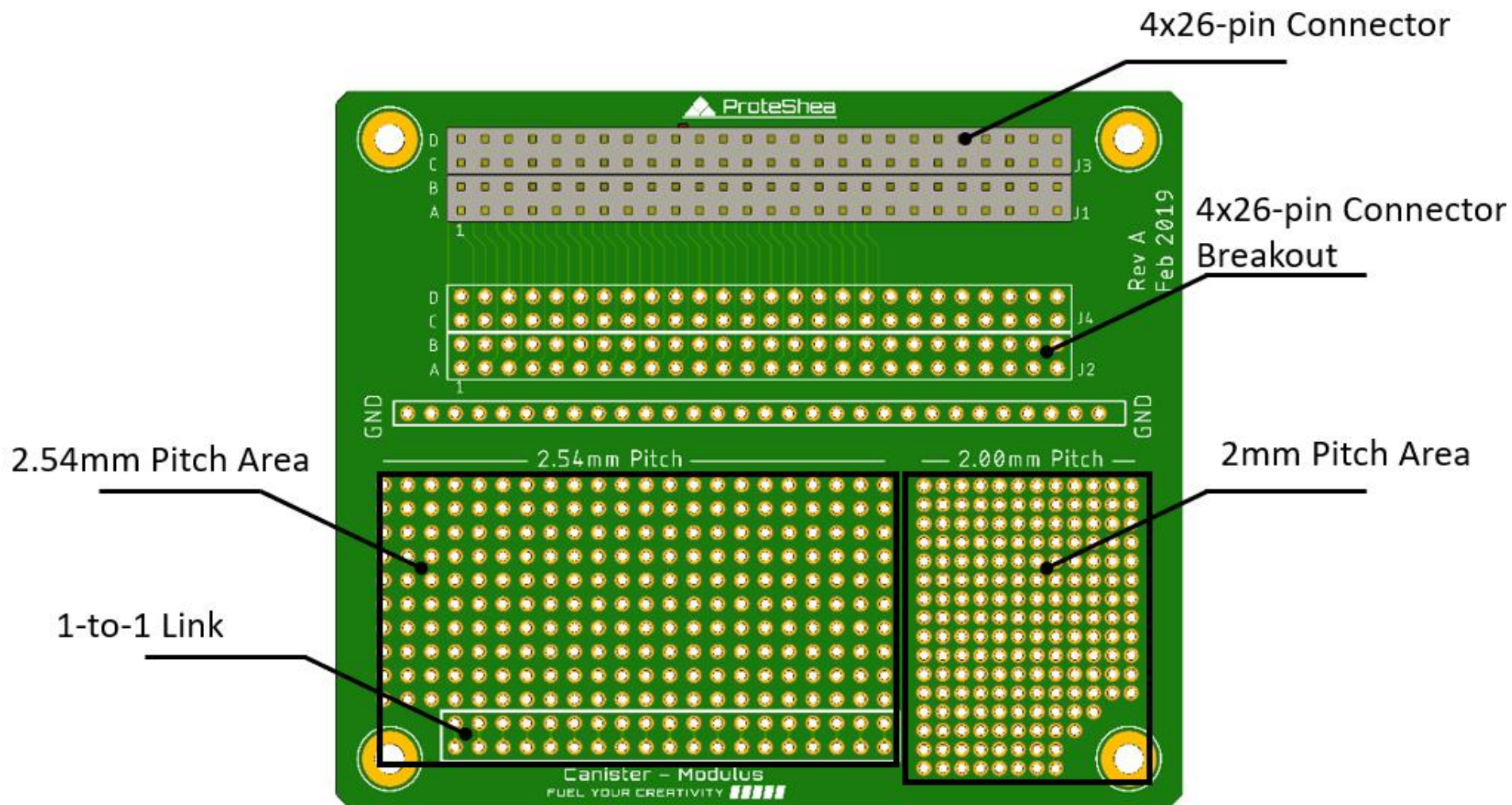


Figure 2. Modulus™ Description.

## G. HOW TO USE PRODUCT

Table 3. Pinout for 4x26-pin Connector.

	1	2	3	4	5	6	7	8	9	10	11	12	13
D	GPIO-D01	GPIO-D02	GPIO-D03	GPIO-D04	GPIO-D05	GPIO-D06	GPIO-D07	GPIO-D08	GPIO-D09	GPIO-D10	GPIO-D11	GPIO-D12	GPIO-D13
C	GPIO-C01	GND	GPIO-C03	GND	GPIO-C05	GND	GPIO-C07	GND	GPIO-C09	GND	GPIO-C11	GND	GPIO-C13
B	GND	GPIO-B02	GND	GPIO-B04	GND	GPIO-B06	GND	GPIO-B08	GND	GPIO-B10	GND	GPIO-B12	GND
A	GPIO-A01	GPIO-A02	GPIO-A03	GPIO-A04	GPIO-A05	GPIO-A06	GPIO-A07	GPIO-A08	GPIO-A09	GPIO-A10	GPIO-A11	GPIO-A12	GPIO-A13

	14	15	16	17	18	19	20	21	22	23	24	25	26
GPIO-D14	GPIO-D15	GPIO-D16	GPIO-D17	GPIO-D18	GND	+5V0	GND	+3V3	GND	+12V0	GND	-12V0	
GND	GPIO-C15	GND	GPIO-C17	GPIO-C18	GND	+5V0	GND	+3V3	GND	+12V0	GND	-12V0	
GPIO-B14	GND	GPIO-B16	GND	GPIO-B18	GND	+5V0	GND	+3V3	GND	+12V0	GND	-12V0	
GPIO-A14	GPIO-A15	GPIO-A16	GPIO-A17	GPIO-A18	GND	+5V0	GND	+3V3	GND	+12V0	GND	-12V0	

Table 3 shows the pinouts for the 4x26-pin connector which is the receptacle header shown in Fig. 2. This header has a 1-to-1 pin link to the 4x26 Connector Breakout also shown in Fig. 2.

The 1-to-1 link provides wire-wrapping capability to any sensor or module that may need to be configured on the edge of the board (i.e. LCD, right-angle sensors). The board routing for this feature is shown in Figure 3 and an example design is shown in Figure 4. By using through-hole header pins, right-angle receptacle, and an LCD display, you can easily integrate a space-saving design. Wire-wrap can be used to connect the header pins to other solder points or installed pins on the Canister.

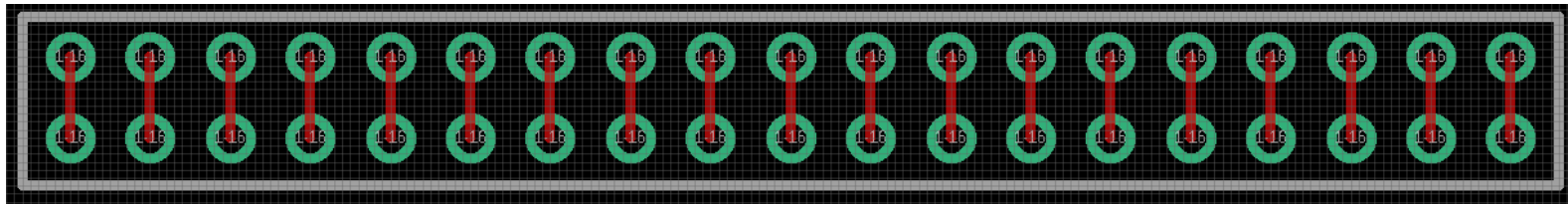


Figure 3. Modulus™ 1-to-1 Link.

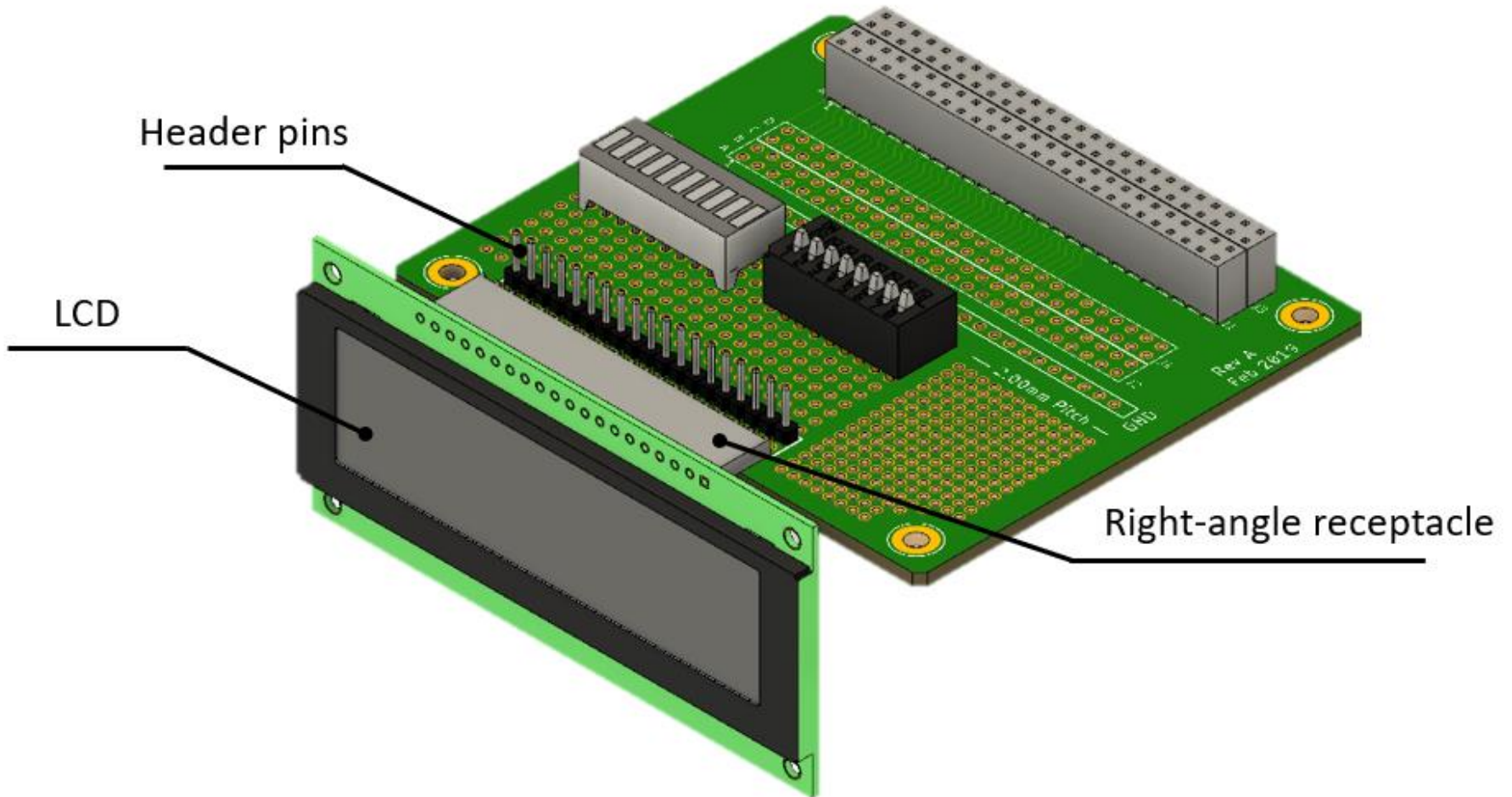


Figure 4. Using 1-to-1 Link Example.



**ELECTRIC SHOCK WARNING:** Plugging in the Canister to the Main Interface board improperly could pose a potential risk of fire, damage, electric shock, or injury.

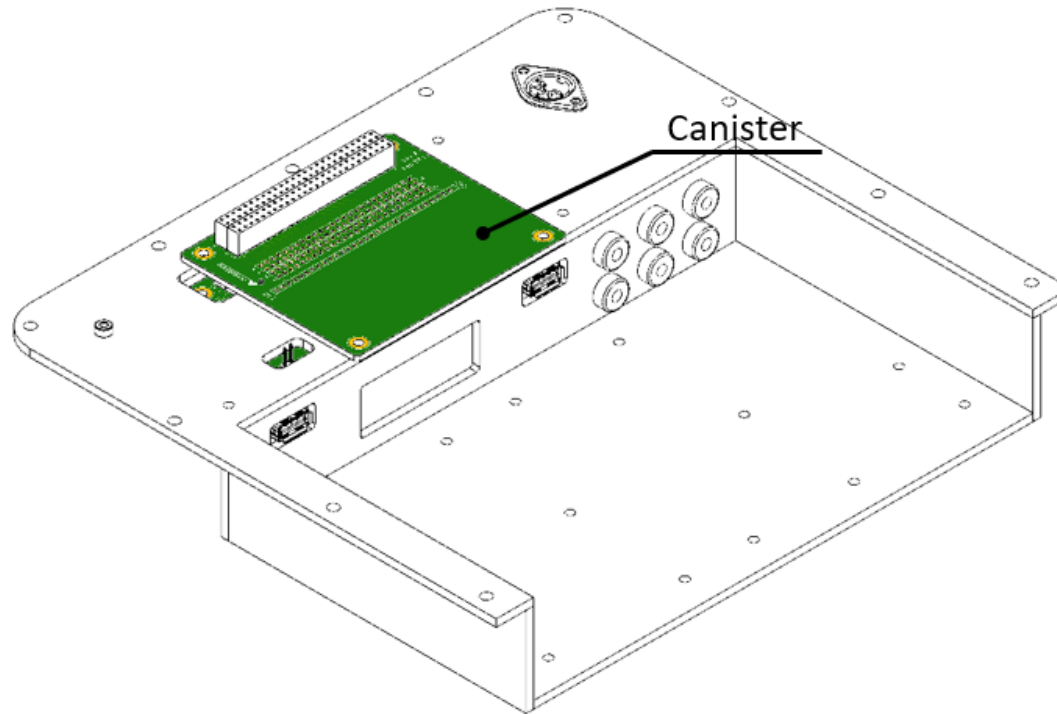


Figure 5. Installation of Canister in FuelCan™.

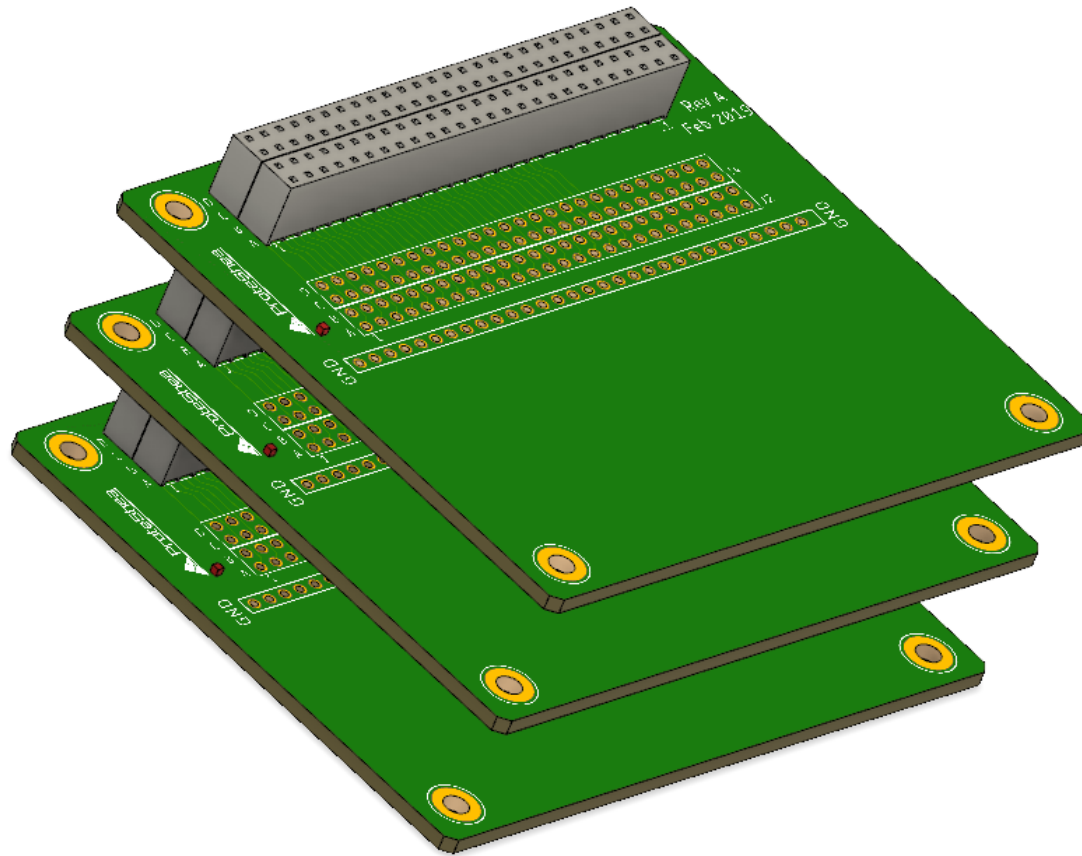


Figure 6. Example Canister Stack.

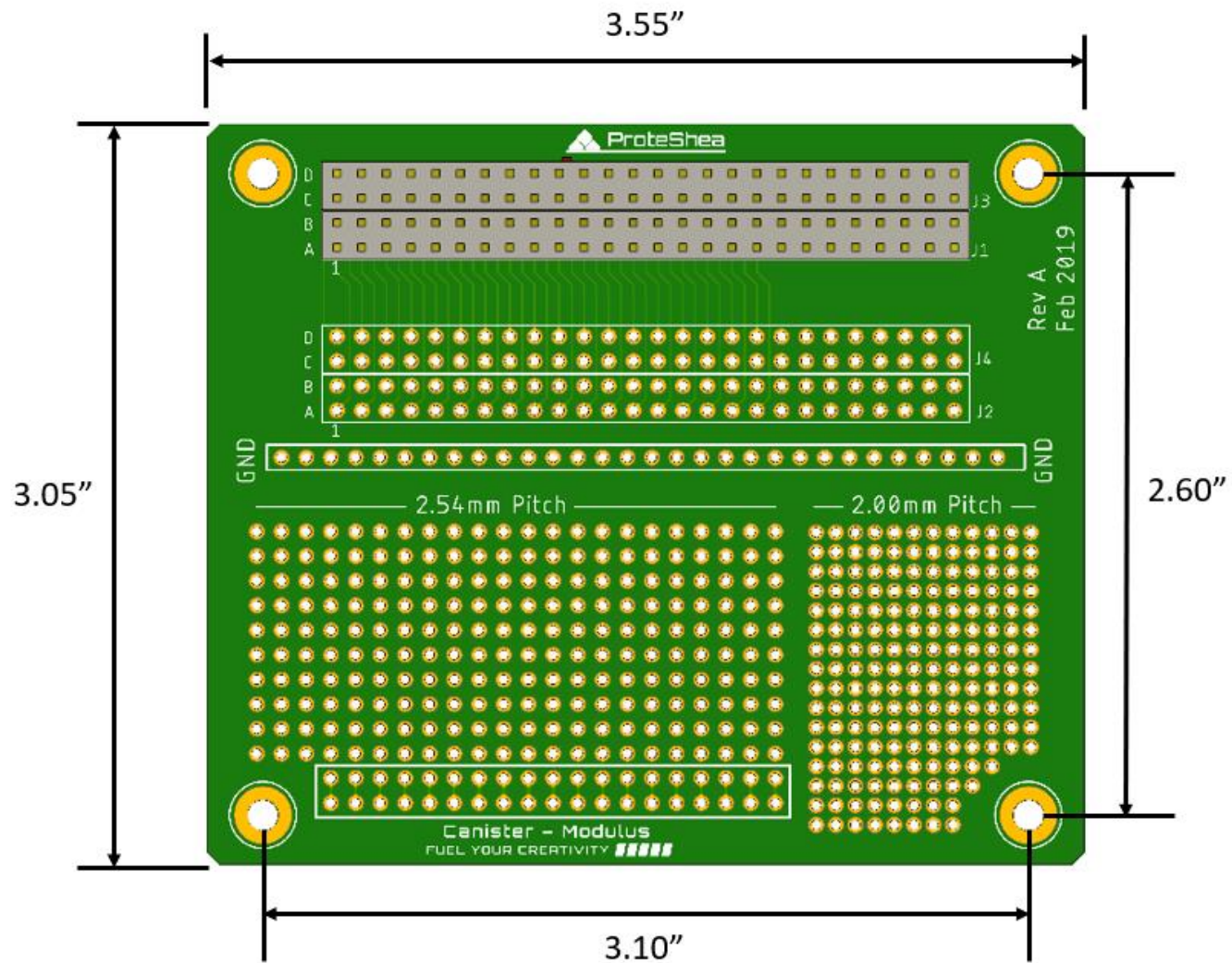


Figure 7. Modulus™ Dimensions.

## H. INSTALLATION

Visit us at <https://proteshea.com/canisters> to find up-to-date information and how-to videos for the Canister.

Follow the steps below for first-time operation of the Canister:



**ELECTRIC SHOCK WARNING:** Never use the FuelCan with a damaged AC-DC Adaptor or power outlet cable. There is a potential danger of fatal electric shock.

Never plug in a Canister while the FuelCan is powered. There is a potential danger of fatal electric shock.



**WARNING:** Do not apply excessive force when plugging in Canister since this could crack the acrylic subassembly or damage the connector pins.



**ESD CAUTION**

1. Inspect AC-DC Adaptor and power cables to ensure there are no cuts, defects, or other damages. Do not proceed if any damage is found.
2. Inspect the acrylic subassemblies on the FuelCan to ensure there are no cracks or other damage. Do not proceed if any damage is found.
3. Use Fig. 8 below to correctly orientate the Canister with the Fuelcan Main Interface or another Canister by aligning pin A1 on both boards.
4. Use two hands and apply even pressure on both sides of the Canister (areas marked in red in Fig. 9) to press into Main Interface board or another Canister board.



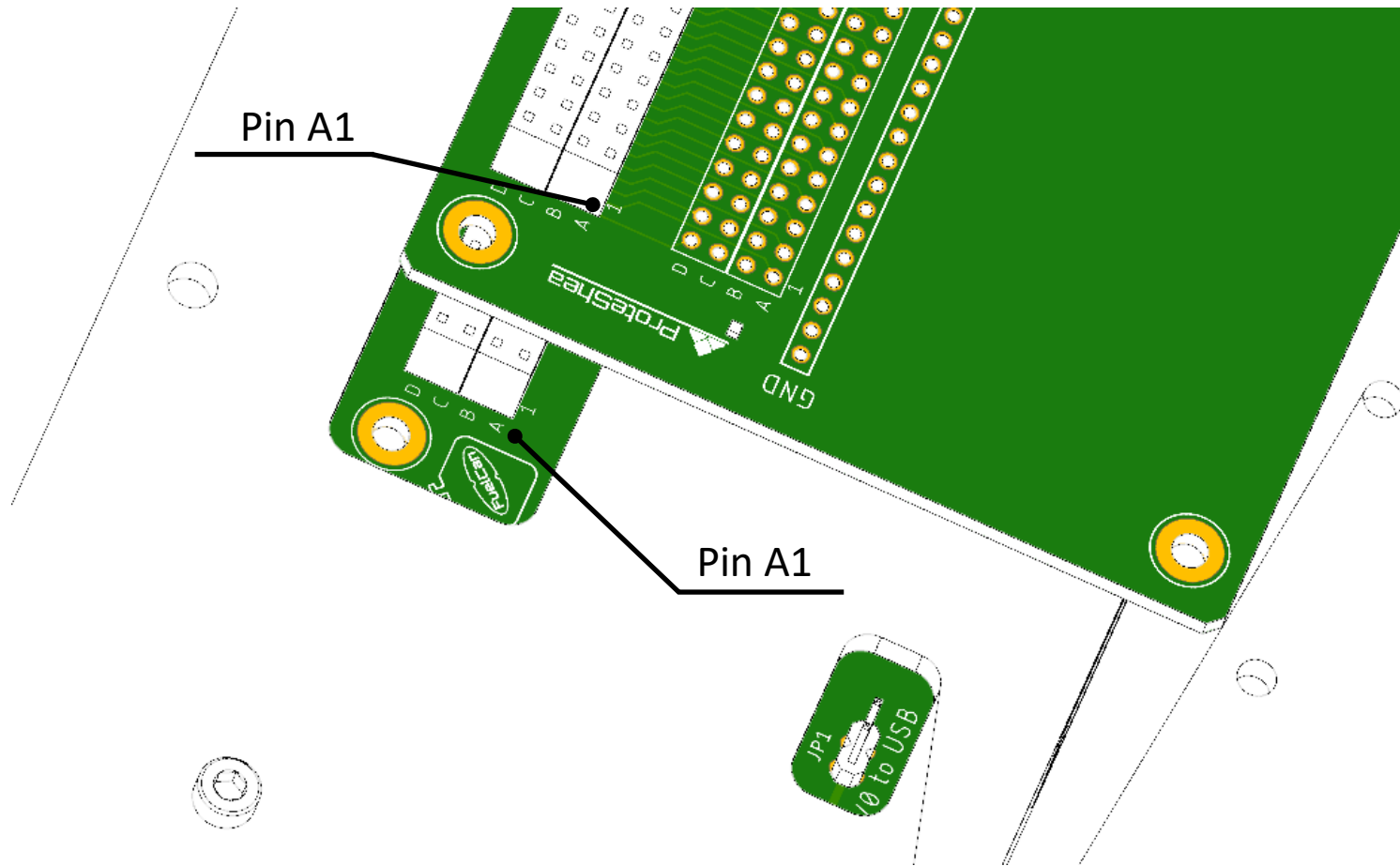


Figure 8. Proper Alignment of Canister to Main Interface Board.

## I. REMOVAL

Follow the steps below for removal of the Canister from the FuelCan Main Interface board:



**ELECTRIC SHOCK WARNING:** Never use the FuelCan with a damaged AC-DC Adaptor or power outlet cable. There is a potential danger of fatal electric shock.

Never plug in a Canister while the FuelCan is powered. There is a potential danger of fatal electric shock.



**WARNING:** Do not apply excessive force when removing Canister since this could crack the acrylic subassembly or damage the connector pins.



**ESD CAUTION**

1. Unplug the FuelCan to power down the voltage supplies to the Canister.
2. Use two hands and apply even pressure on both sides of the Canister (areas marked in red in Fig. 9) to pull the board vertically out of the Main Interface board.

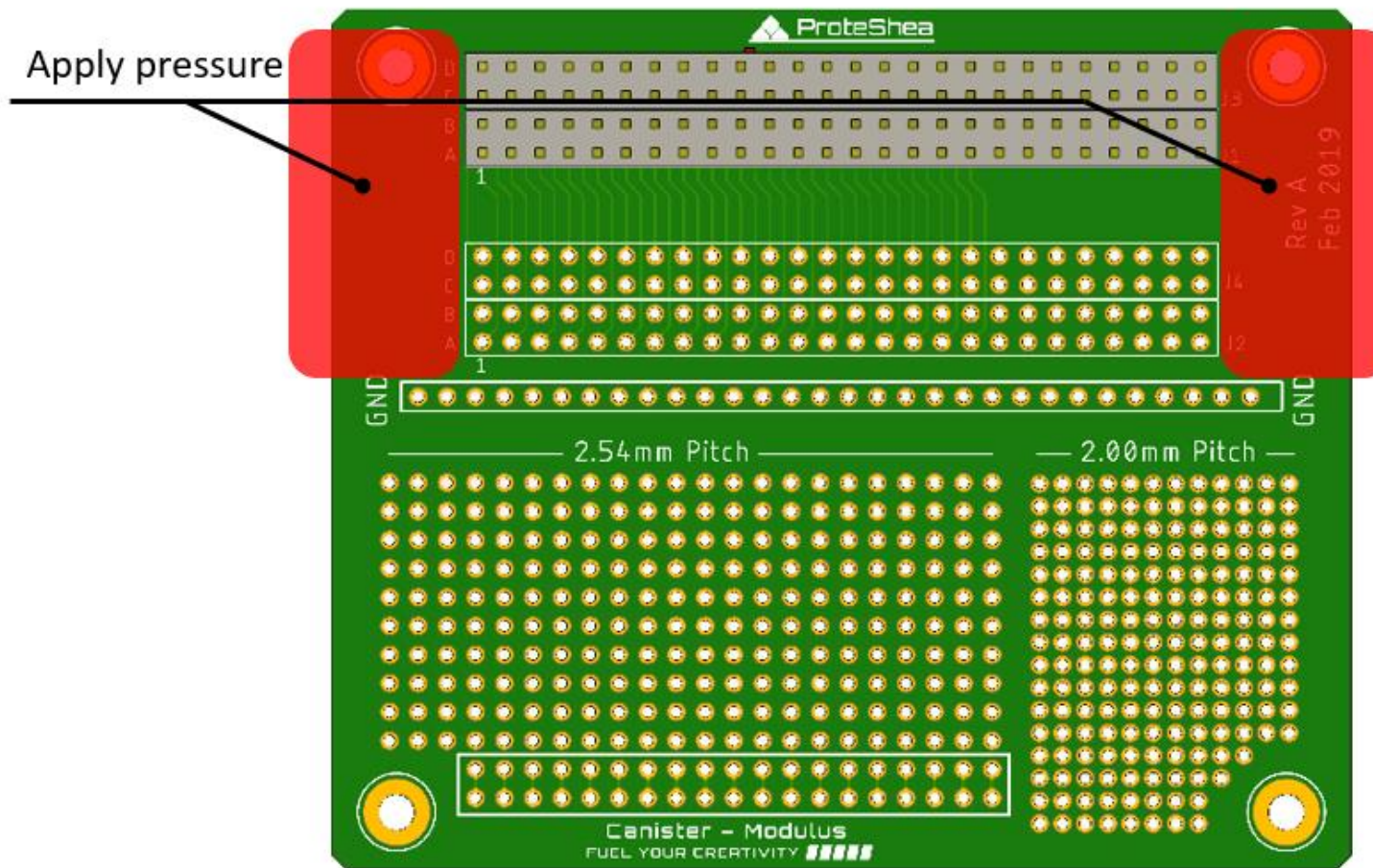


Figure 9. Areas to Apply Pressure for Installation or Removal.

## J. OPERATION

Follow the steps below for operation of the Canister:



**ELECTRIC SHOCK WARNING:** Never use the FuelCan with a damaged AC-DC Adaptor or power cable. There is a potential danger of fatal electric shock.

Never plug in a Canister while the FuelCan is powered. There is a potential danger of fatal electric shock.



**ESD CAUTION**

1. Inspect AC-DC Adaptor and power cables to ensure there are no cuts, defects, or other damages. Do not proceed if any damage is found.
2. Inspect the acrylic subassemblies on the FuelCan to ensure there are no cracks or other damage. Do not proceed if any damage is found.
3. Use Table 3 to properly use the GPIO (general purpose input output) and power pins on the 4x26-pin connector.
4. Solder desired sensors, switches, or LEDs to the 2.54mm or 2.00mm sections of the board. An example design is shown in Fig. 4.
5. Inspect Canister for short-circuits before plugging into Main Interface board of FuelCan or into Canister stack.

## K. MAINTENANCE

To ensure the longevity of your Canister, take proper precautions as listed below:

- Use two hands and apply even pressure to carefully plug-in or remove the Canister
- Inspect soldered wires for damage which could lead to potential short-circuits
- Store the Canister in a cool, dry place.
- Use only for intended purposes – see **INTENDED USES** section.

## L. TROUBLESHOOTING

<b>Problem</b>	<b>Cause</b>	<b>Solution</b>
No power to Canister	AC-DC adaptor shutdown voltage rails due to circuit protection	Unplug power, remove Canister and inspect for shorts
Not enough solder points on Canister	Limited board size for CubeSat form-factor	Stack more than one Modulus Canister to achieve desired number of solder points
Signal integrity issues from Canister to development board on FuelCan	Common ground wire not present in signal wire harness	Add ground wires between Canister and development board (the more the better)

**M. INDEX****A**

Address page 23

**C**

Canister

How to use page 10

Support page 23

Website page 23

Connector (4x26-pin)

Pinout page 10

Orientation page 17

Contact details page 23

**D**

Dimensions page 15

**E**

ESD caution page 4

Example design page 12

**F**

Features page 7

First time use page 16

**I**

Installation page 16

Intended uses page 6

**L**

Legal information page 24

**M**

Maintenance page 21

Mass page 8

**P**

Phone page 23

**R**

Rated power page 8

Removal page 18

**S**

Safety page 5

Warning symbol description page 4

System overview page 9

**T**

Technical specifications page 8

Terms and conditions page 24

Troubleshooting page 21

**W**

Website page 23

## N. CONTACT INFORMATION

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Please send us your feedback and/or concerns by visiting <https://proteshea.com/contact/> or via email at [support@proteshea.com](mailto:support@proteshea.com)

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**LIMITATION OF WARRANTY.** The warranty set forth below, applies only to the original customer and is based solely on the judgment and discretion of ProteShea. The warranty does not cover bent or damaged connector pins. ProteShea shall not be liable and this warranty shall not apply if any defects or damages are caused by or result from, without limitation, modifications to the Canister by anyone other than ProteShea, accident, abuse, mishandling, normal wear and tear, or irresponsible use of the Canister. PROTESHEA SPECIFICALLY DISCLAIMS THE WARRANTY FOUND IN UCC SECTION 2-312(3) THAT THE CANISTER SHALL BE DELIVERED FREE OF THE RIGHTFUL CLAIM OF ANY THIRD PERSON BY WAY OF INFRINGEMENT. EXCEPT FOR THE EXPRESSED WARRANTY SET FORTH IN THIS AGREEMENT, PROTESHEA DISCLAIMS ANY AND ALL OTHER EXPRESSED OR IMPLIED WARRANTIES, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHETHER WRITTEN OR ORAL.

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