



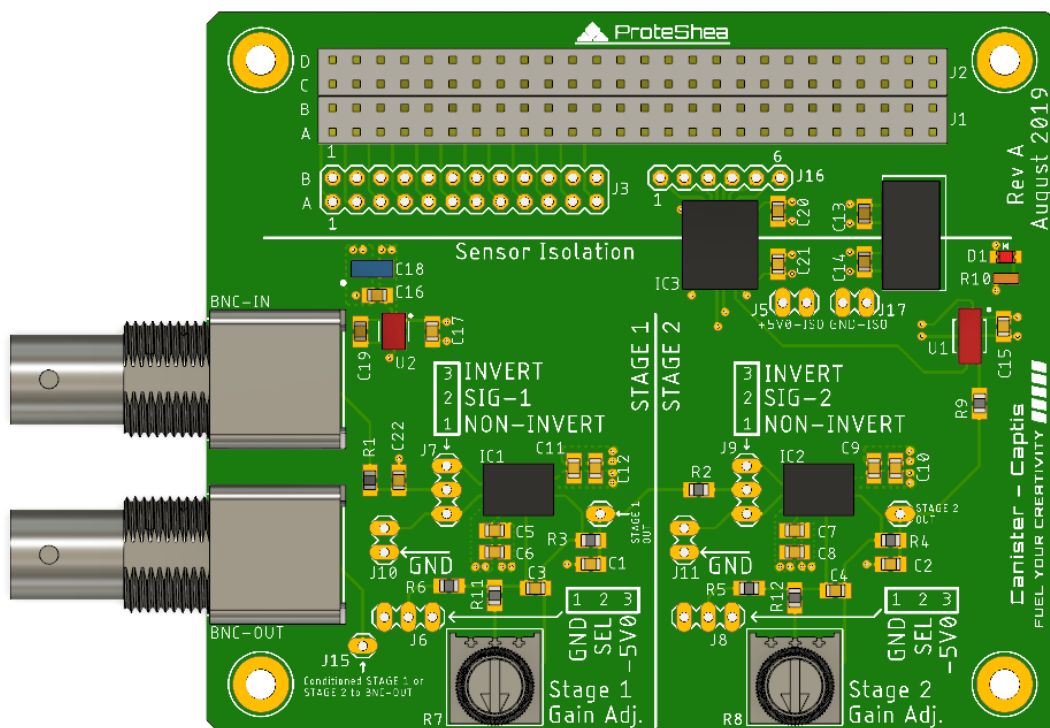
ProteShea®

Learn. Apply. Create.™

Canister – Captis™

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

Date	Version	Revision
9/19/2019	1.0	Initial release

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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 in a wet or extreme environment.
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 Captis™ Canister is designed for use with the FuelCan™ and other Canister models (Adapticon™ and/or Modulus™) and can be stacked to provide the user's desired functionality.

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 and Arduino evaluation and development
- Electronics prototyping and evaluation
- Teaching beginner soldering skills
- Teaching board interfacing
- Teaching communication interfaces to sensors
- Teaching power supply design

D. FEATURES


Captis™ Canister contains the following:


- 4x26-pin header compatible with FuelCan™ Main Interface board
- Stackable with other Canister models (i.e. Adapticon)
- Two-stage amplifier with stage-1 and stage-2 gain adjustment
- Configure amplifiers for non-inverting or inverting operation
- 50 ohm BNC connector for input and output (50 ohm)
 - Stage-1 or Stage-2 output from amplifier can be wired to BNC output
- Isolated power and ground to suppress noise introduced by other Canisters
- SPI communication to Analog-to-Digital Converter (ADC)
- +5V to -5V amplifier rail-to-rail voltage
- Front-end high precision amplifier followed by high bandwidth amplifier for driving ADC
- ADC in 8-bit (standard), 10-bit, or 12-bit resolution
- Small board footprint

E. TECHNICAL SPECIFICATIONS

Table 2. Overview of Technical Specification

Model	Canister – Captis™
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 adapter.

 **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

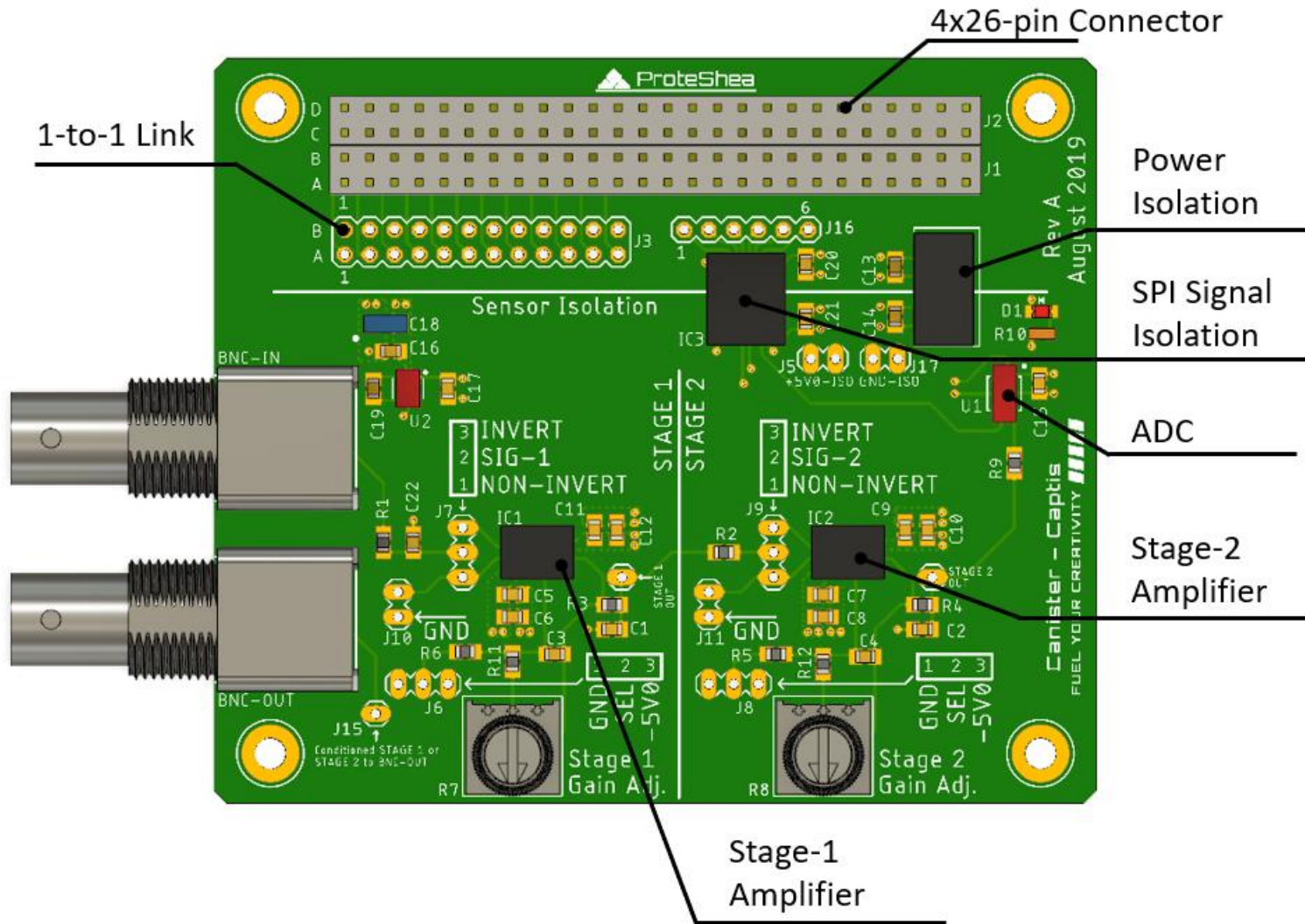


Figure 1. Captis™ Description (Top View).

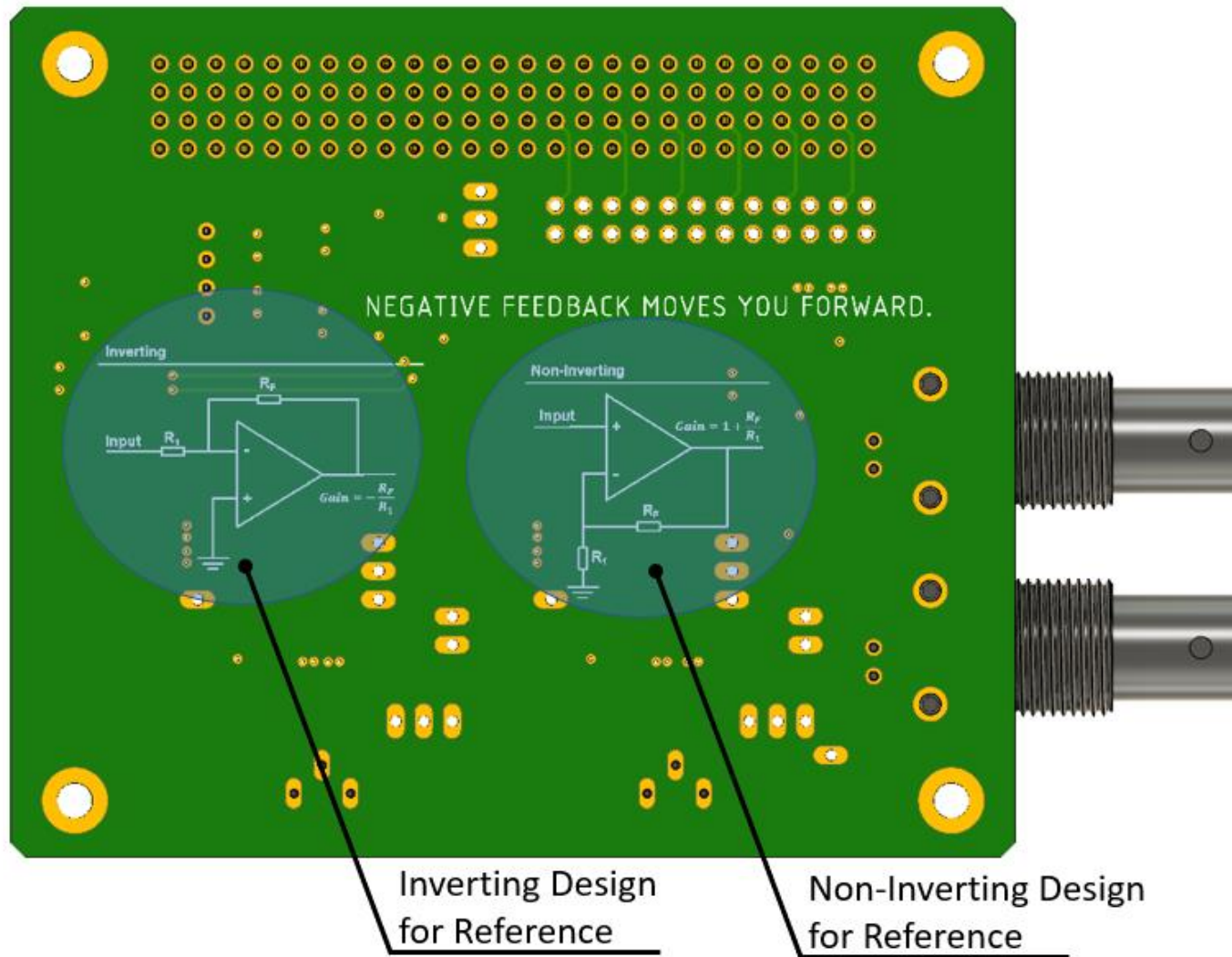


Figure 2. Captis™ Description (Bottom View).

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 as shown in Fig. 1. The 1-to-1 link provides connections to the 4x26-pin connector so that wire wrap can be used to connect from this header to the SPI isolation IC header, labeled as J16. Jumper wires can then be used to connect the 4x26-pin connector to a development board in the FuelCan’s prototyping area.

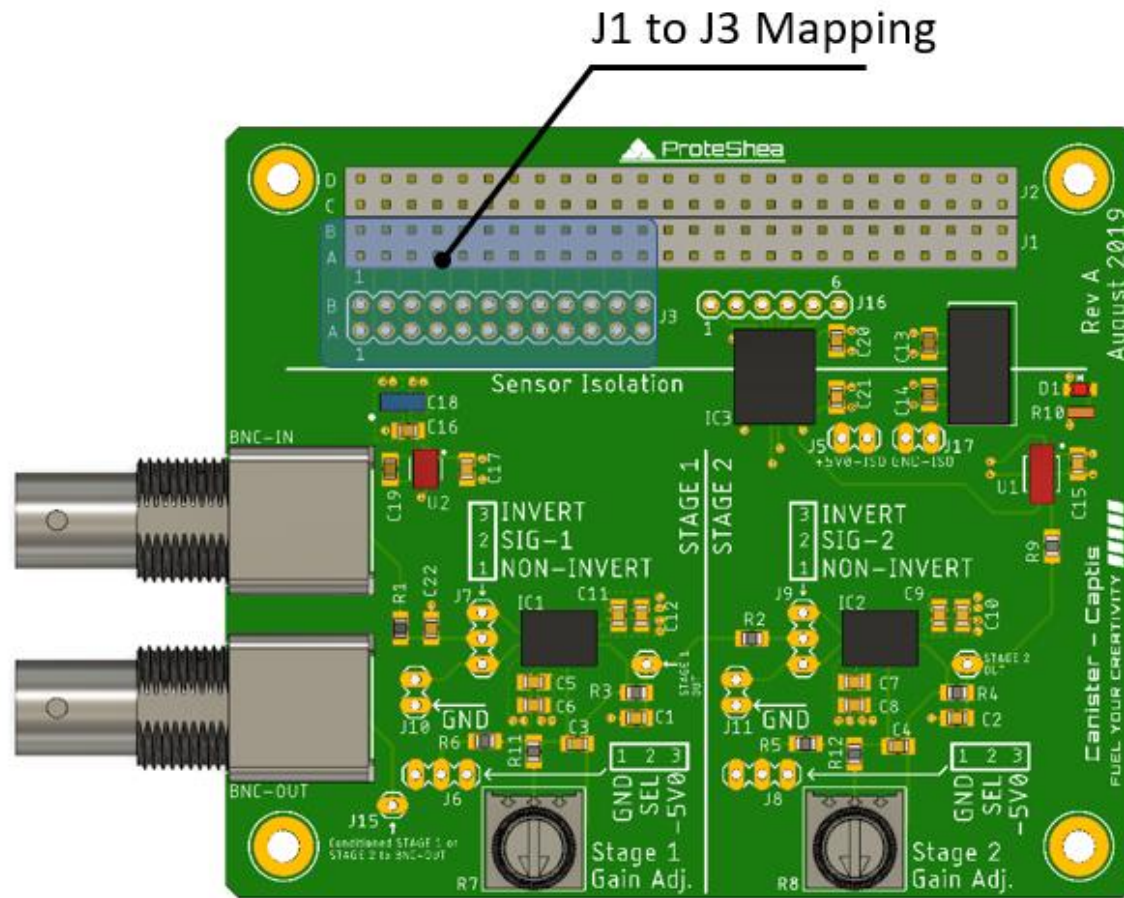


Figure 3. J3 Header Pin Mapping to J1 Header.

The J3 header is a 1-to-1 link to the J1 header (i.e. J3 pin A1 maps to J1 pin A1, J3 pin B1 maps to J1 pin B1, etc.). The design of this header configuration gives the user flexibility when connecting to the 4x26 pin connector since the SPI routing for IC3 is not fixed. See Fig. 12 for a pinout of the SPI connections to J16.

The following figures show how to configure Captis for non-inverting or inverting operation. The schematic is presented first, followed by how to place the fuse jumpers on Captis. An example configuration for Stage-1 and Stage-2 be found here: <https://proteshea.com/process/learn/embedded-systems/uno-rev3-projects/ph-sensor-with-arduino-uno/>

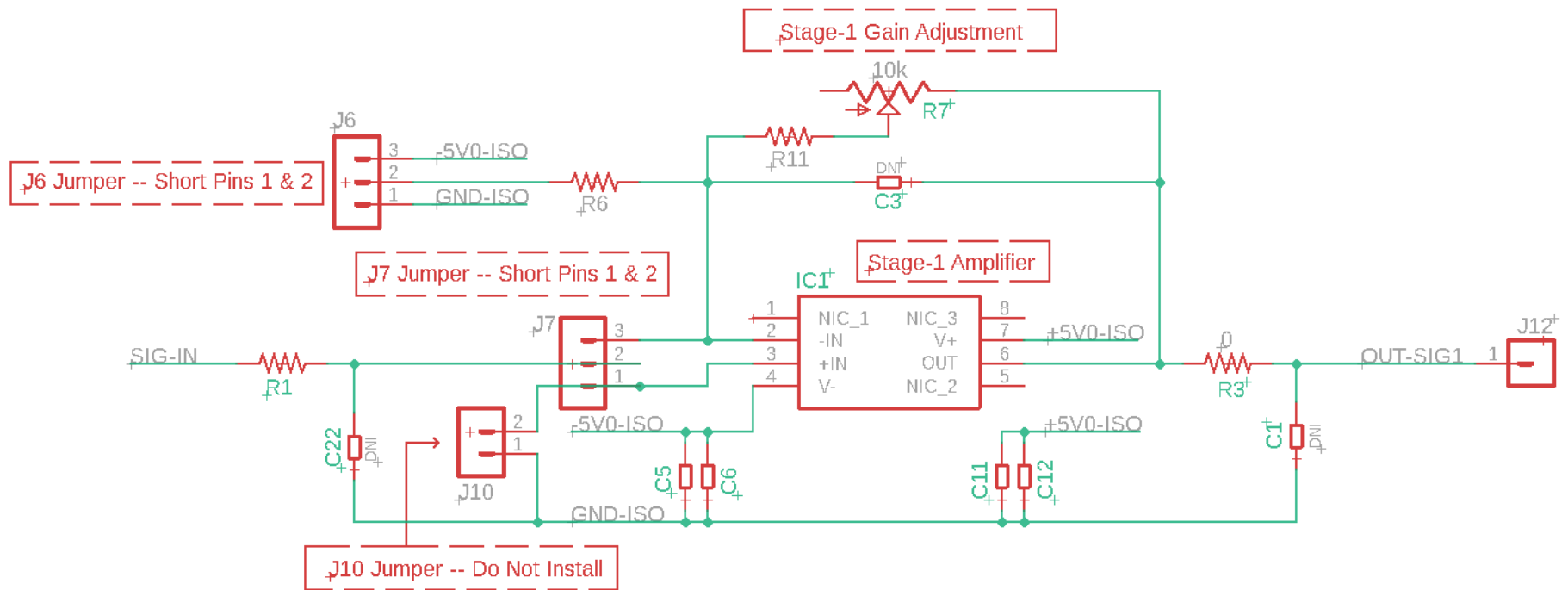
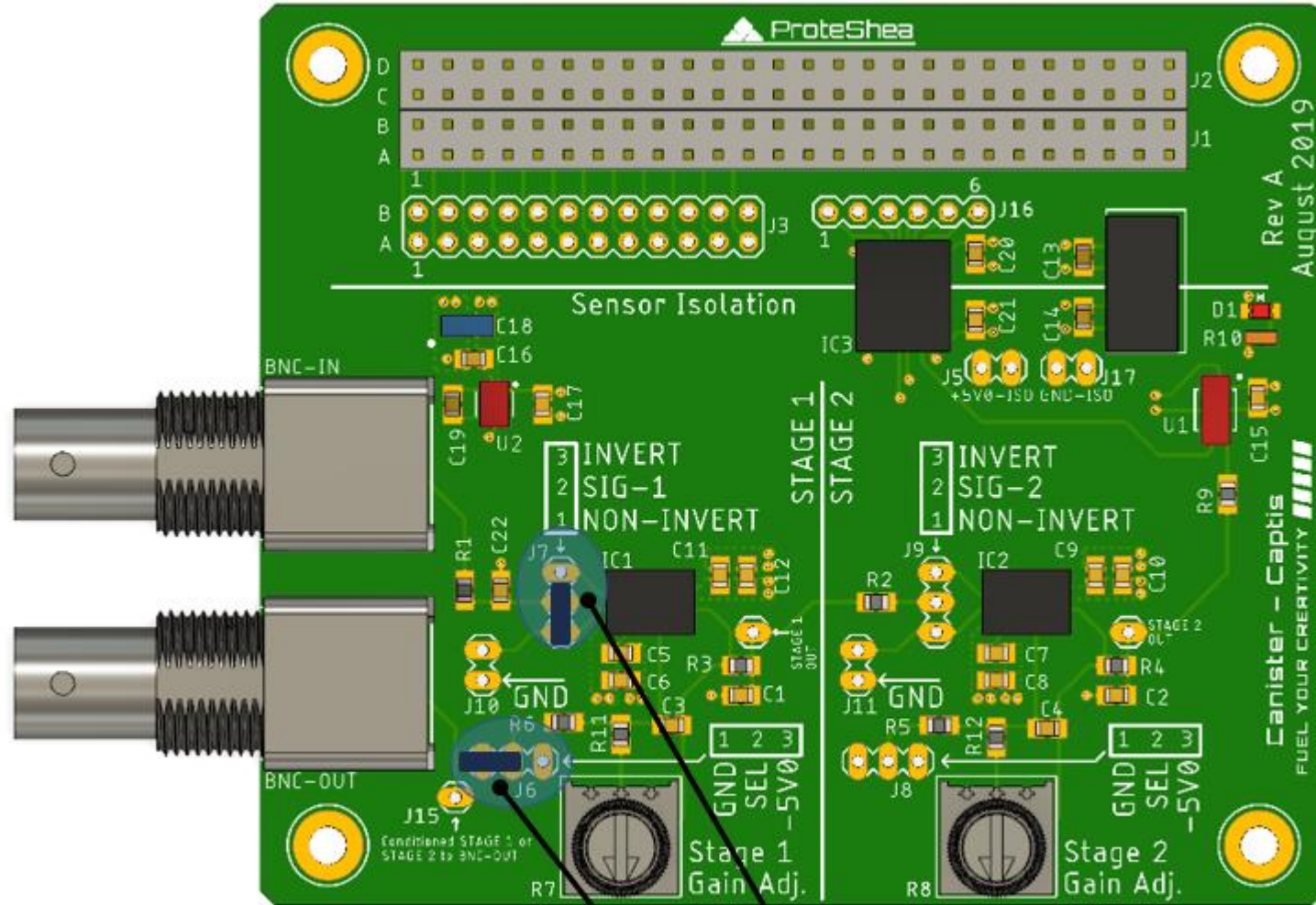


Figure 4. Stage-1 Non-Inverting Configuration.



Installed Jumpers

Figure 5. Jumper Installation for Non-Inverting Stage-1.

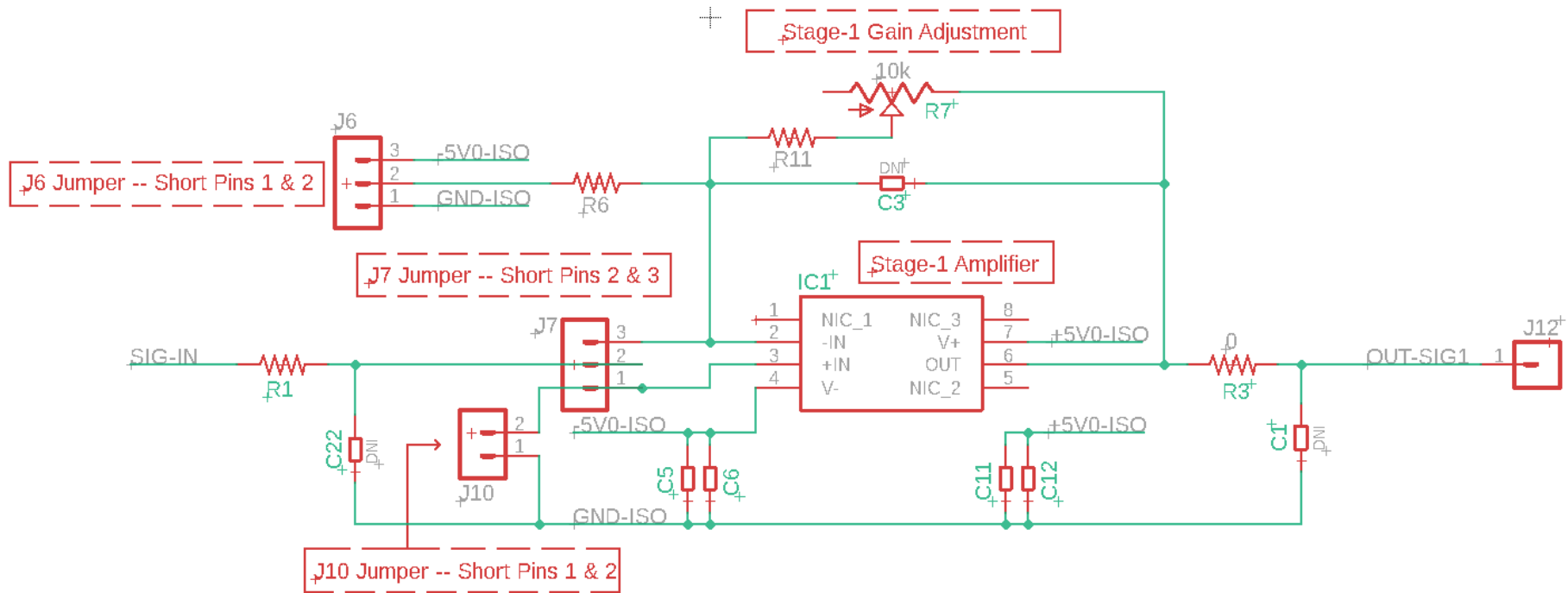


Figure 6. Stage-1 Inverting Configuration.

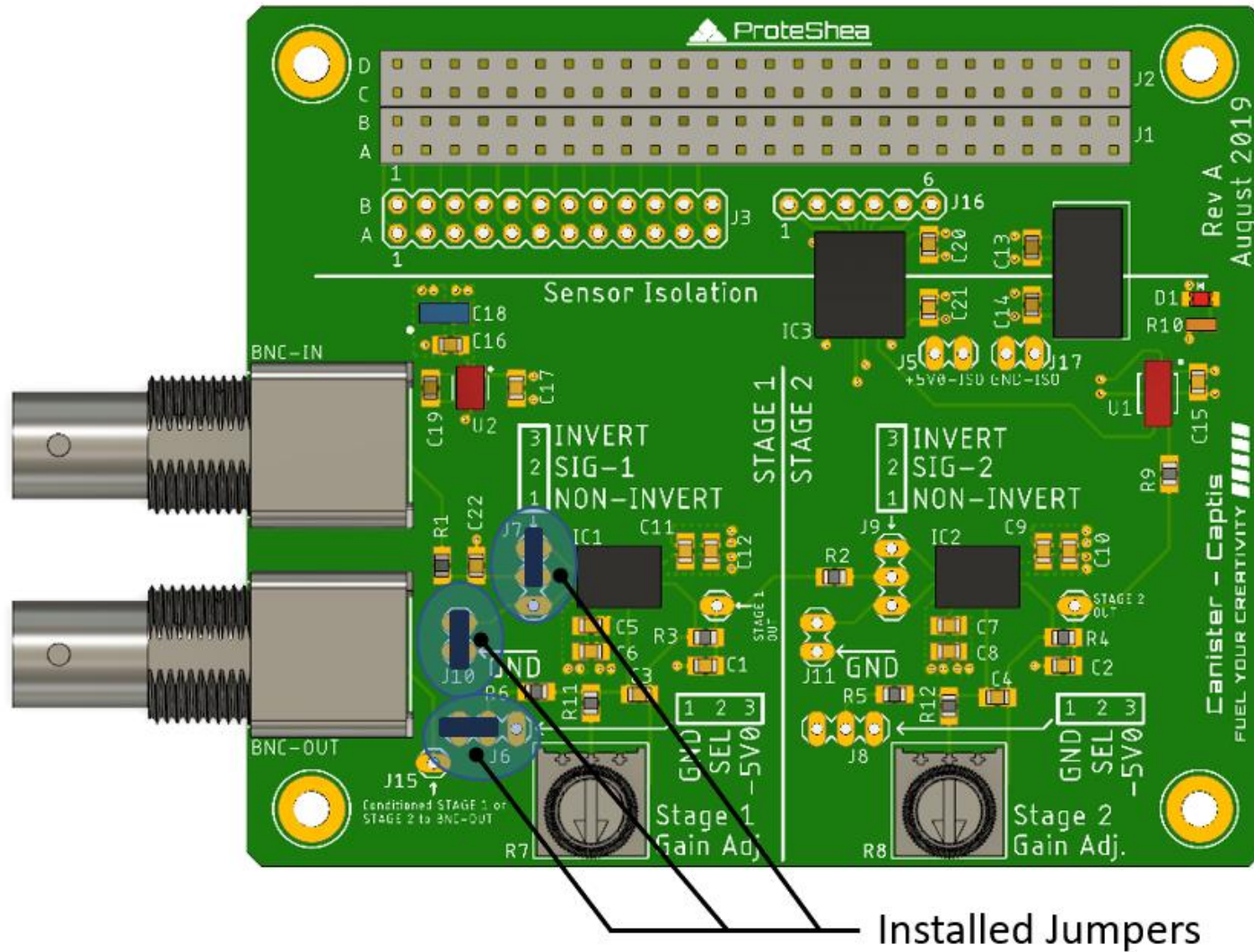


Figure 7. Jumper Installation for Inverting Stage-1.

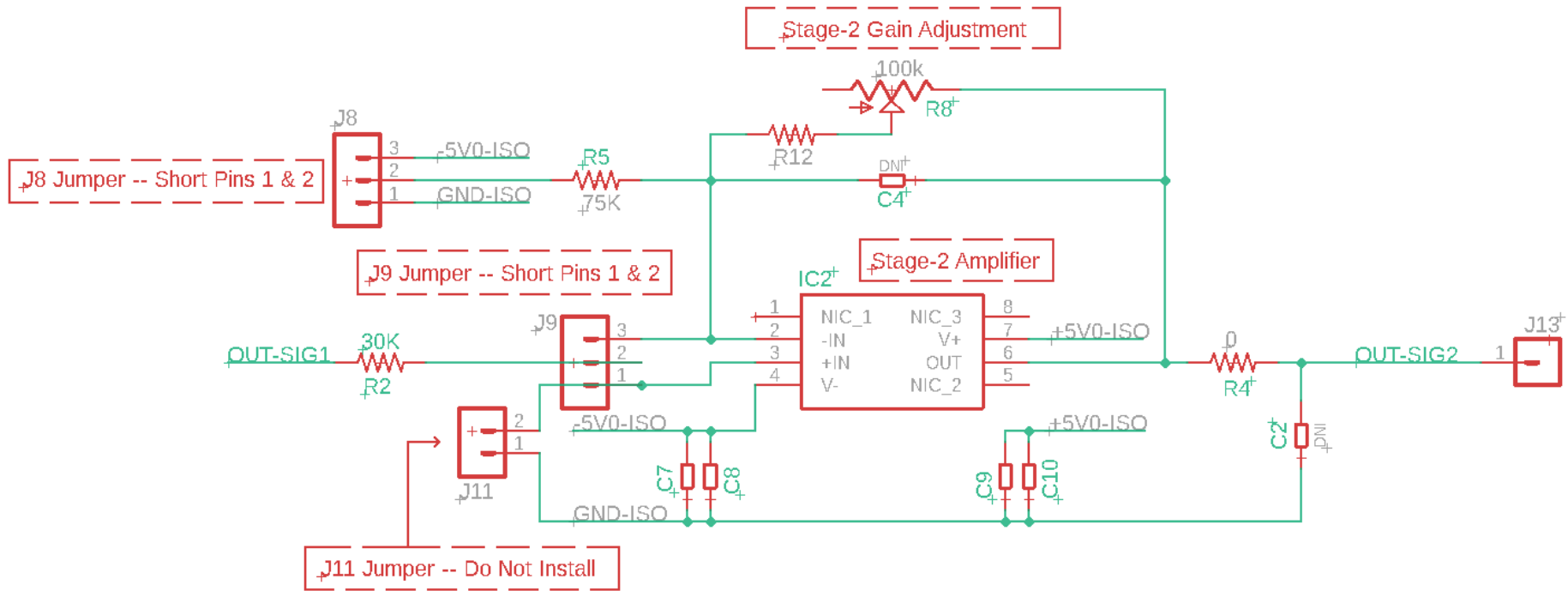


Figure 8. Stage-2 Non-Inverting Configuration.

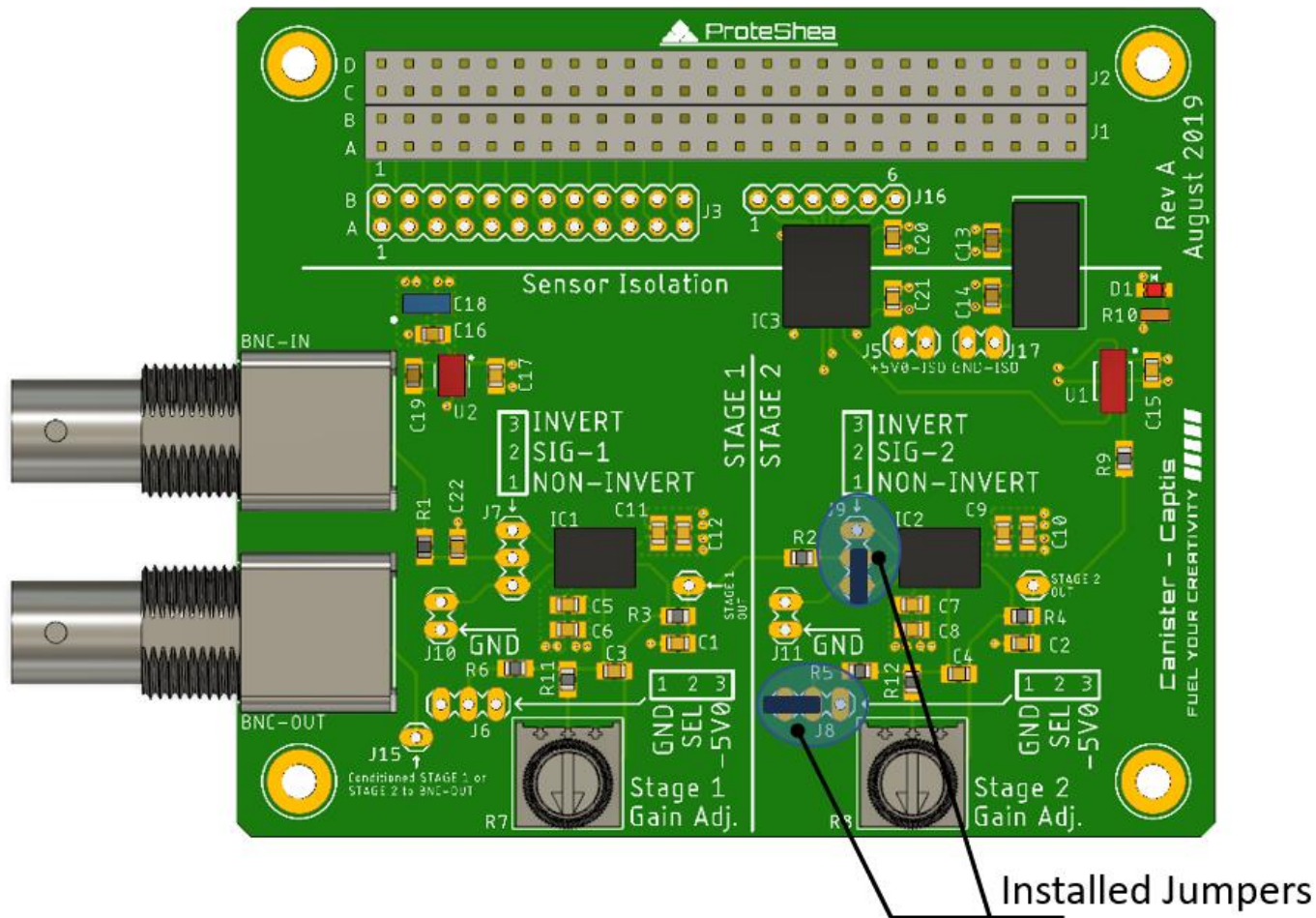


Figure 9. Jumper Installation for Non-Inverting Stage-2.

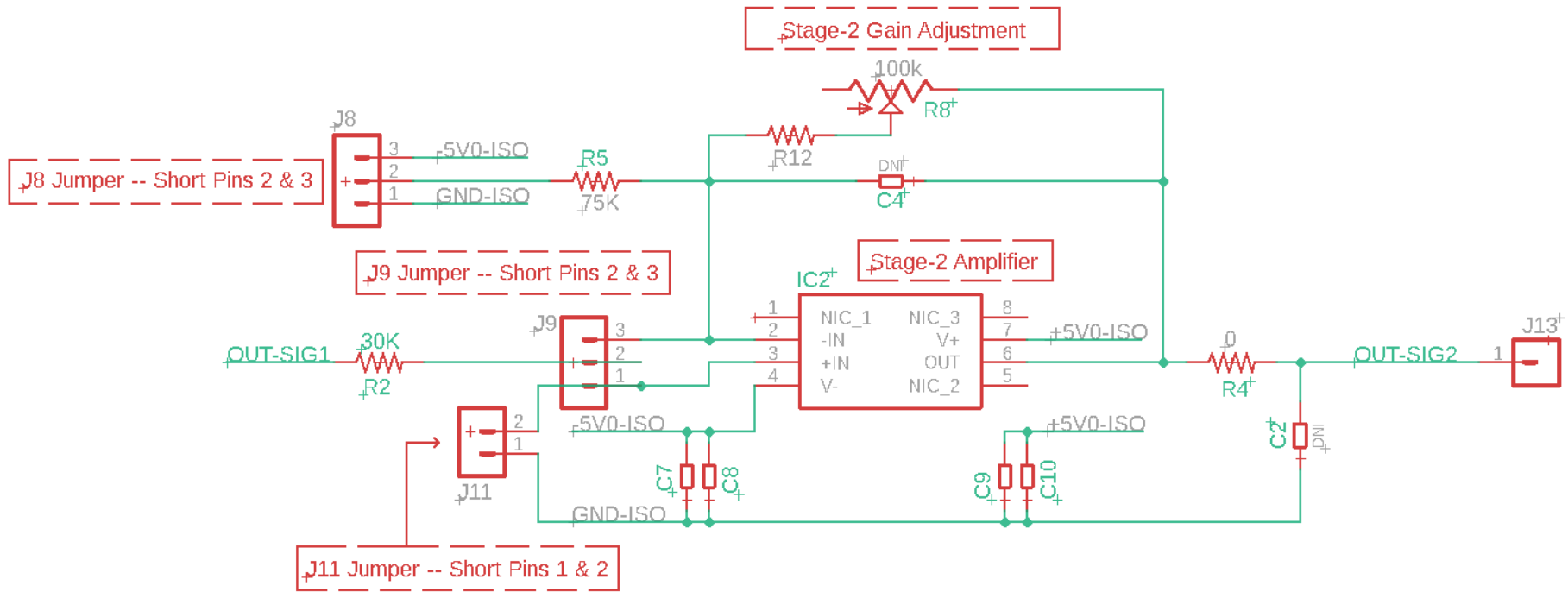


Figure 10. Stage-2 Inverting Configuration.

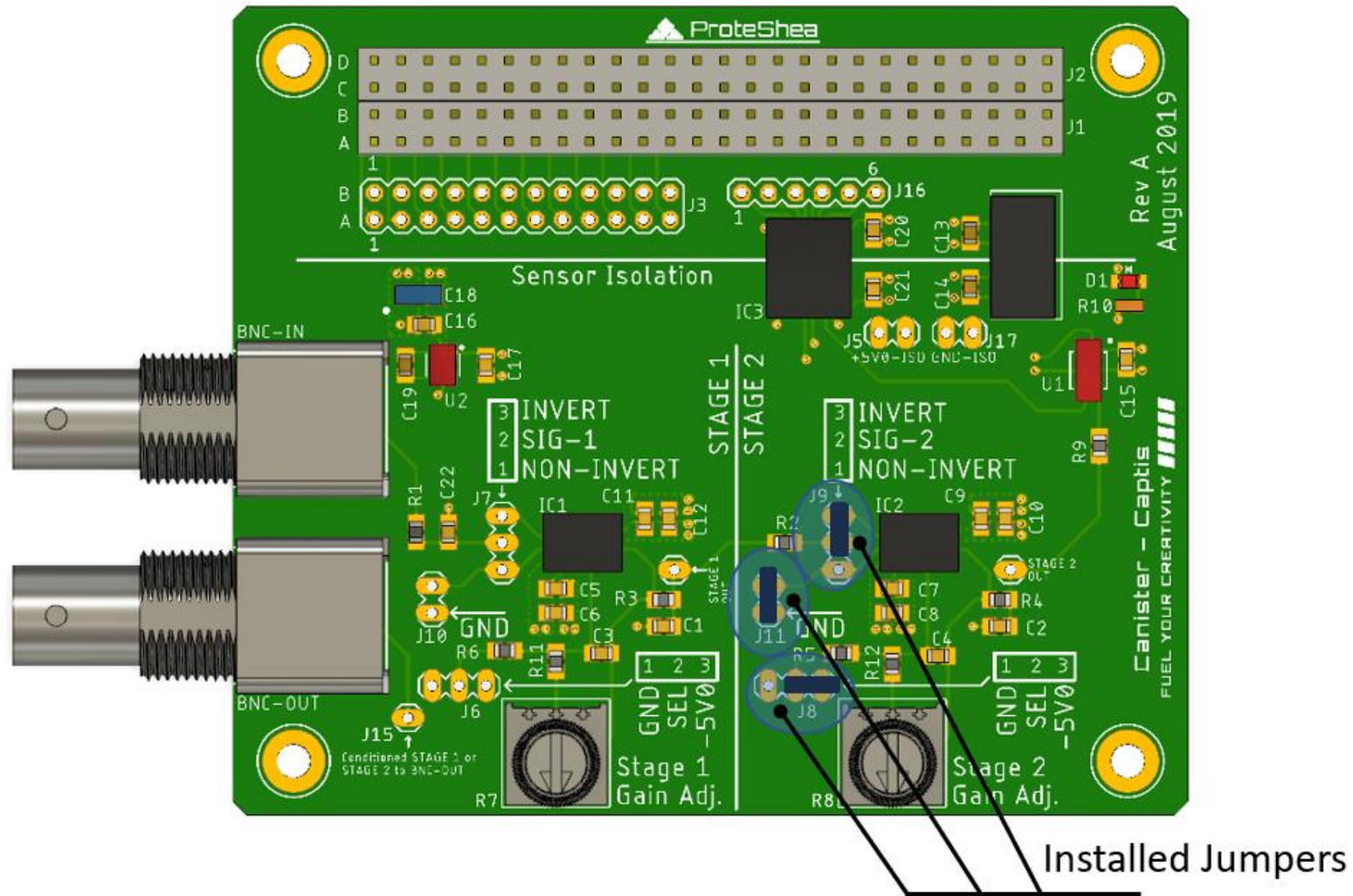


Figure 11. Jumper Installation for Inverting Stage-2.

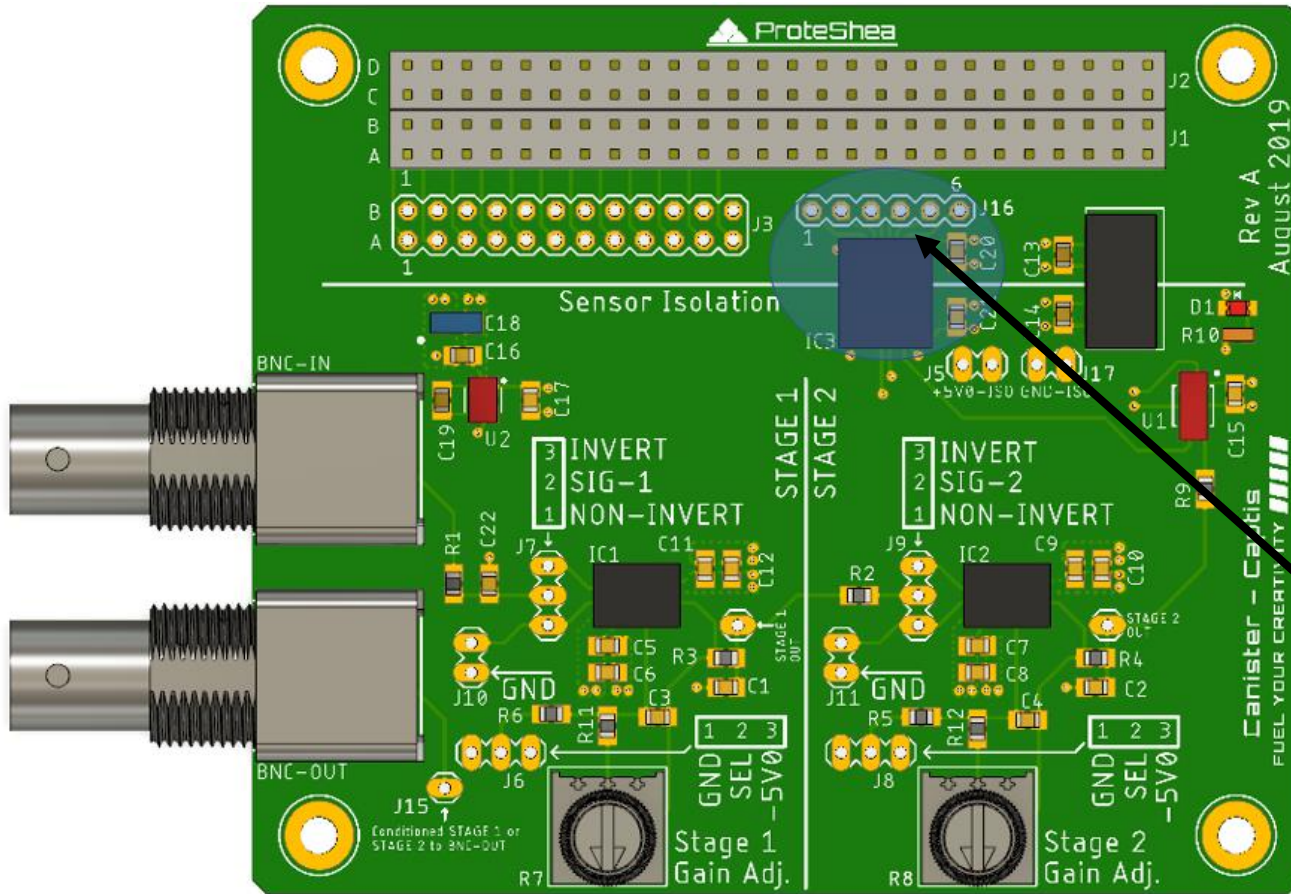


Figure 12. SPI Isolation.

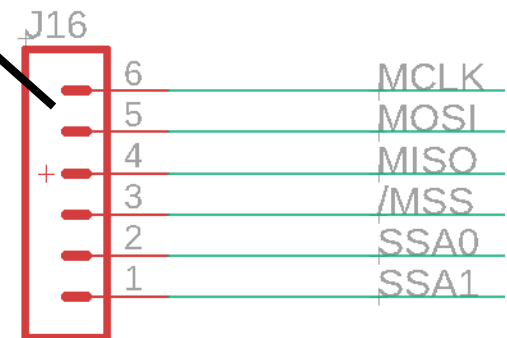


Figure 13. SPI Isolation Pinout.

Wire-wrap or use jumper wires to connect the header pins of J16 to the header pins of the 1-to-1 Link (J3). J3 connects to the 2x26 pin header (J1) (i.e. pin A1 of J1 connects to pin A1 of J3, pin B1 of J1 connects to pin B1 of J3, etc.). This is beneficial since it creates more flexibility with signal routing through the 4x26 pin connector when numerous canisters are stacked.

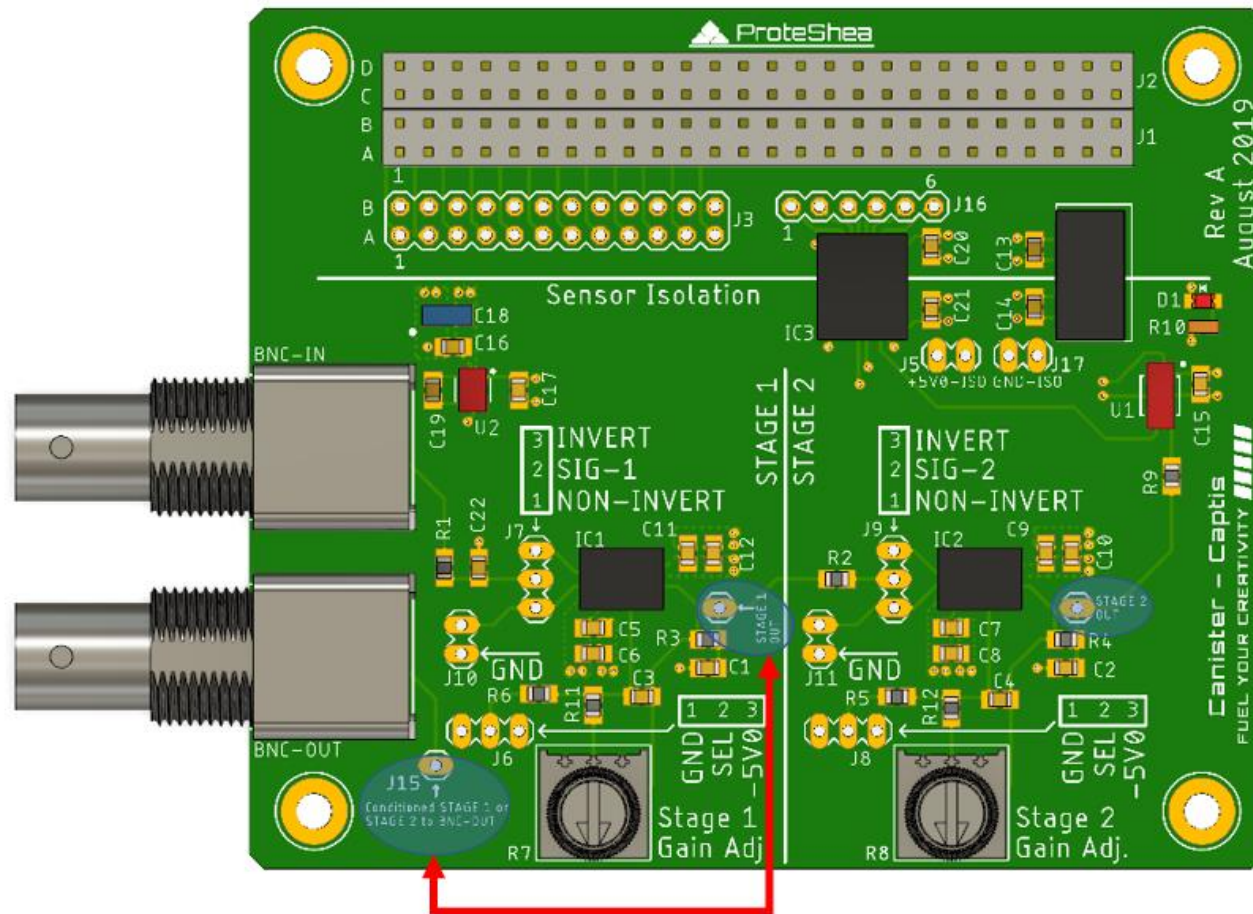


Figure 14. Looping STAGE-1 OUT to BNC-OUT.

The outputs of Stage-1 and Stage-2 can be looped back to the BNC connector labeled “BNC-OUT” as shown in Fig. 14 and 15. If looping Stage-1 back to BNC-OUT, resistor R2 should be removed to limit signal inductance. If looping Stage-2 back to BNC-OUT, resistor R9 should be removed. Use a 6” F/F jumper wire to connect the headers (i.e. “STAGE-1 OUT” to header J15 or “STAGE-2 OUT” to header J15).

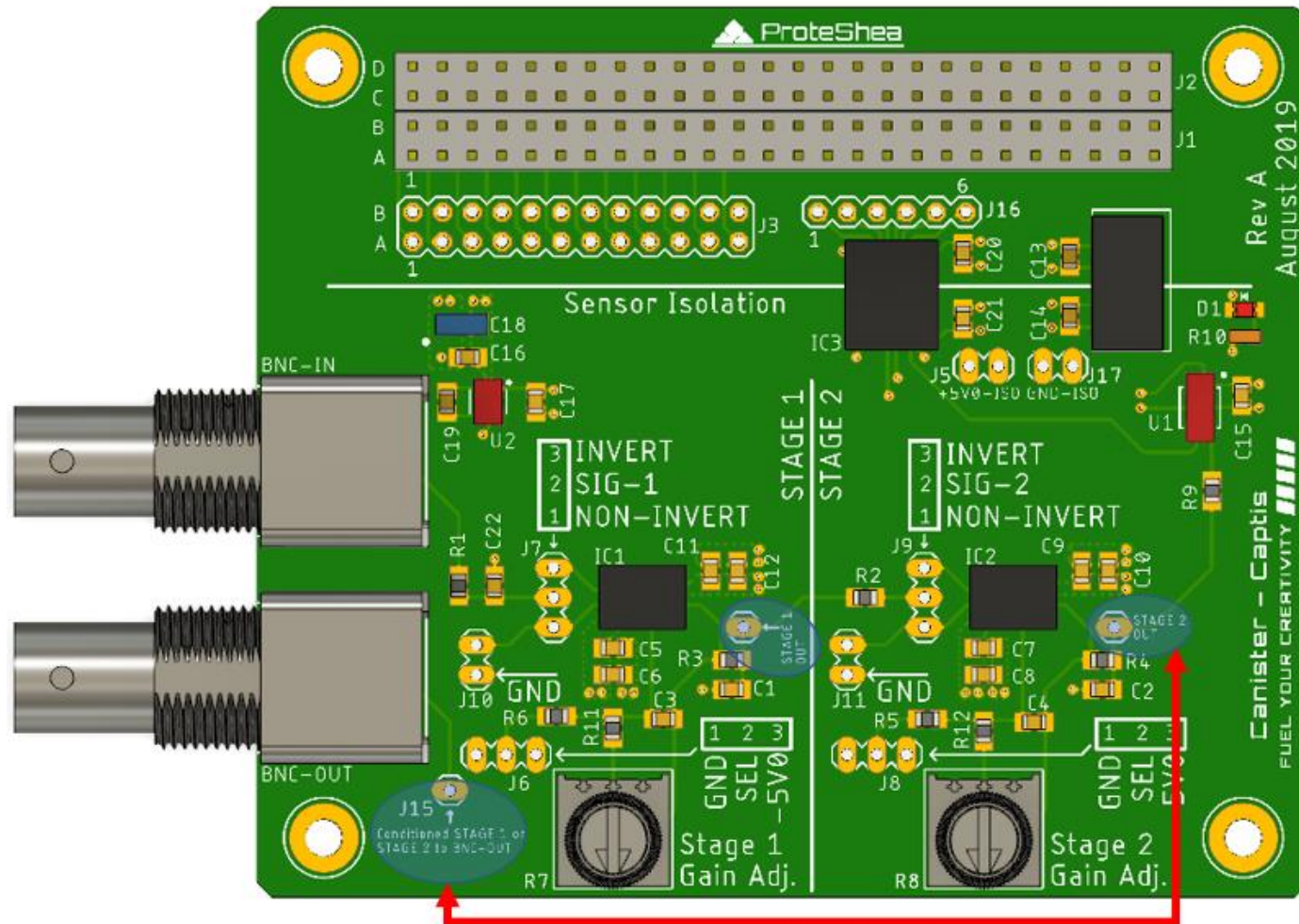


Figure 15. Looping STAGE-2 OUT to BNC-OUT.

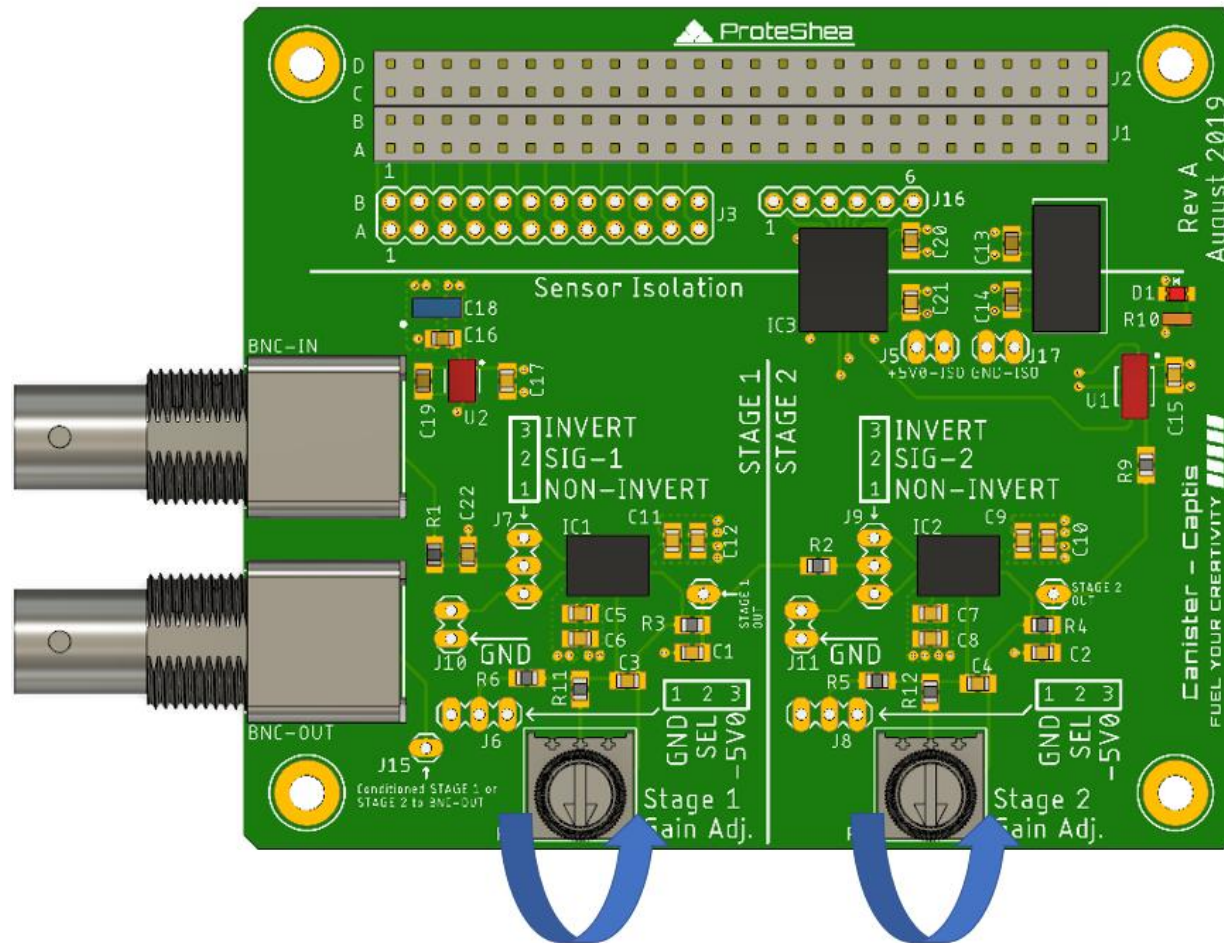


Figure 16. Potentiometer Adjustment.

Tuning Captis can be done using the onboard potentiometers in the image shown above. By turning the potentiometers counterclockwise, the gain of the circuits can be increased. The stage-2 potentiometer can be used as a course tuning of the circuit while the stage-1 potentiometer can be used as a fine tuning mechanism.



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.

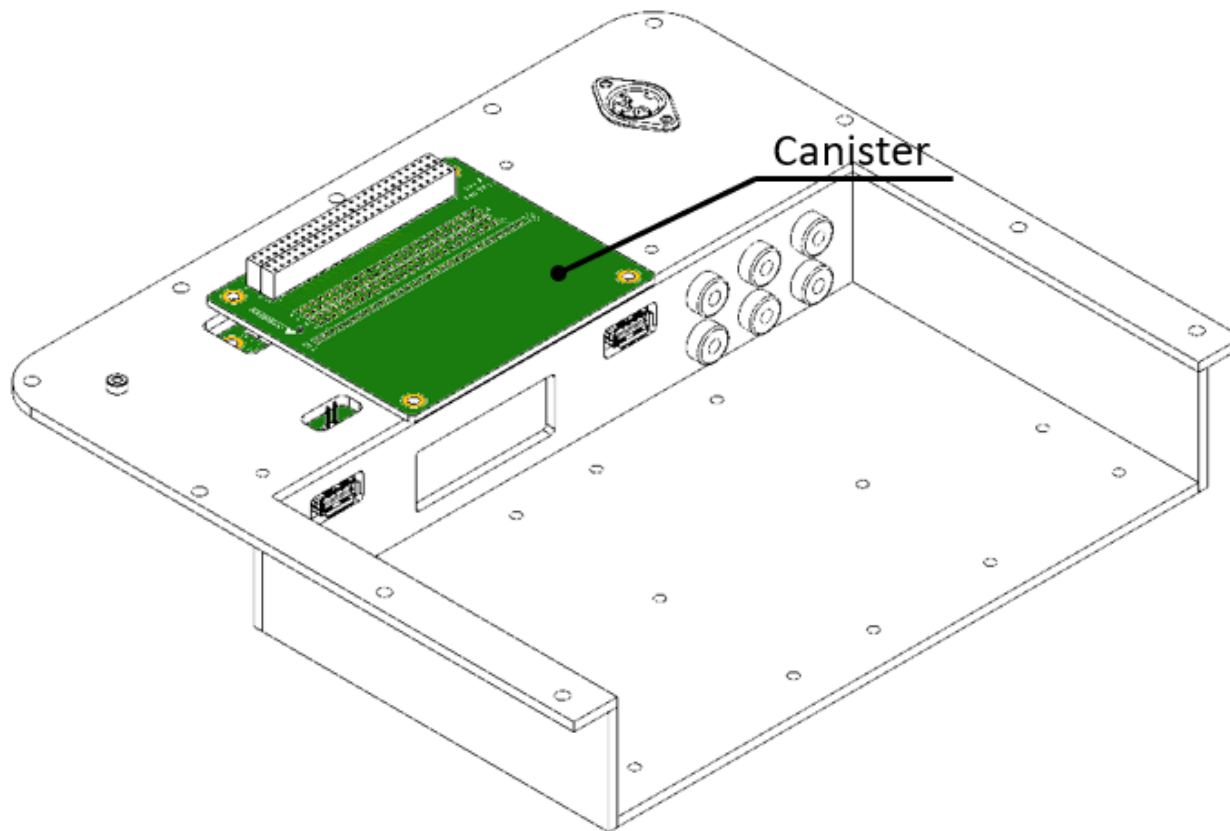


Figure 17. Installation of Canister in FuelCan™.

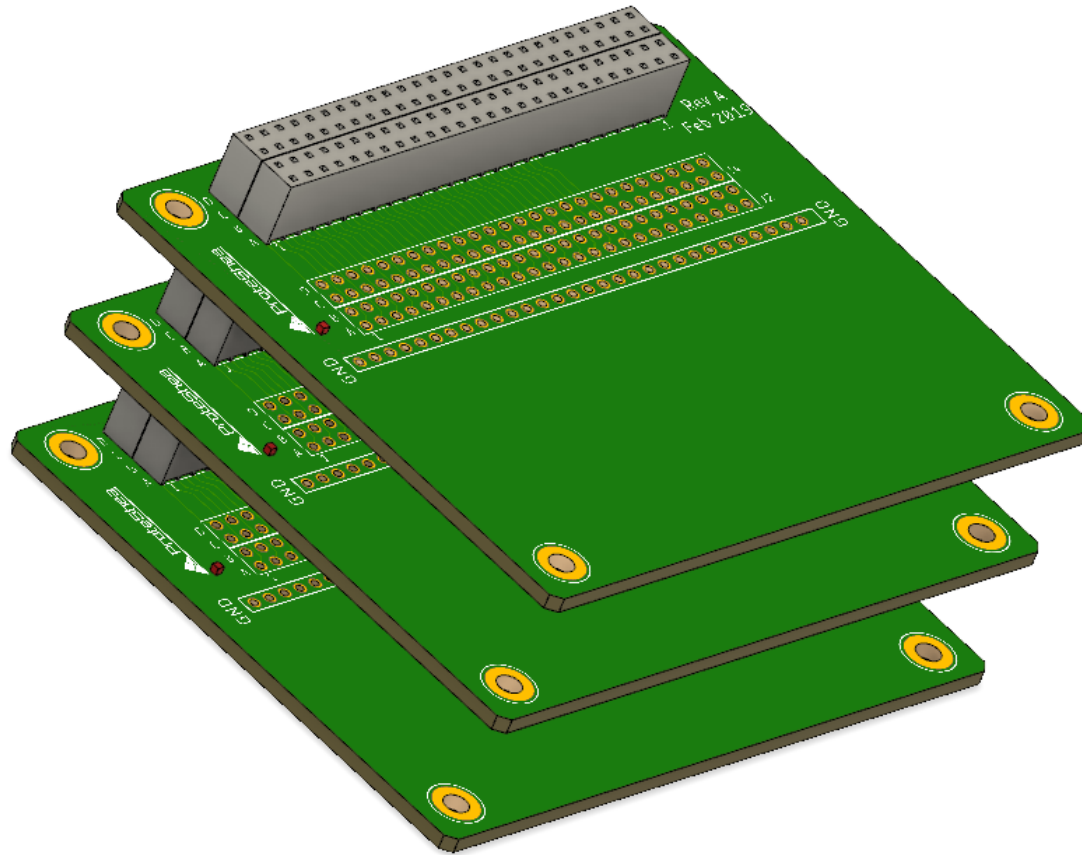


Figure 18. Example Canister Stack.

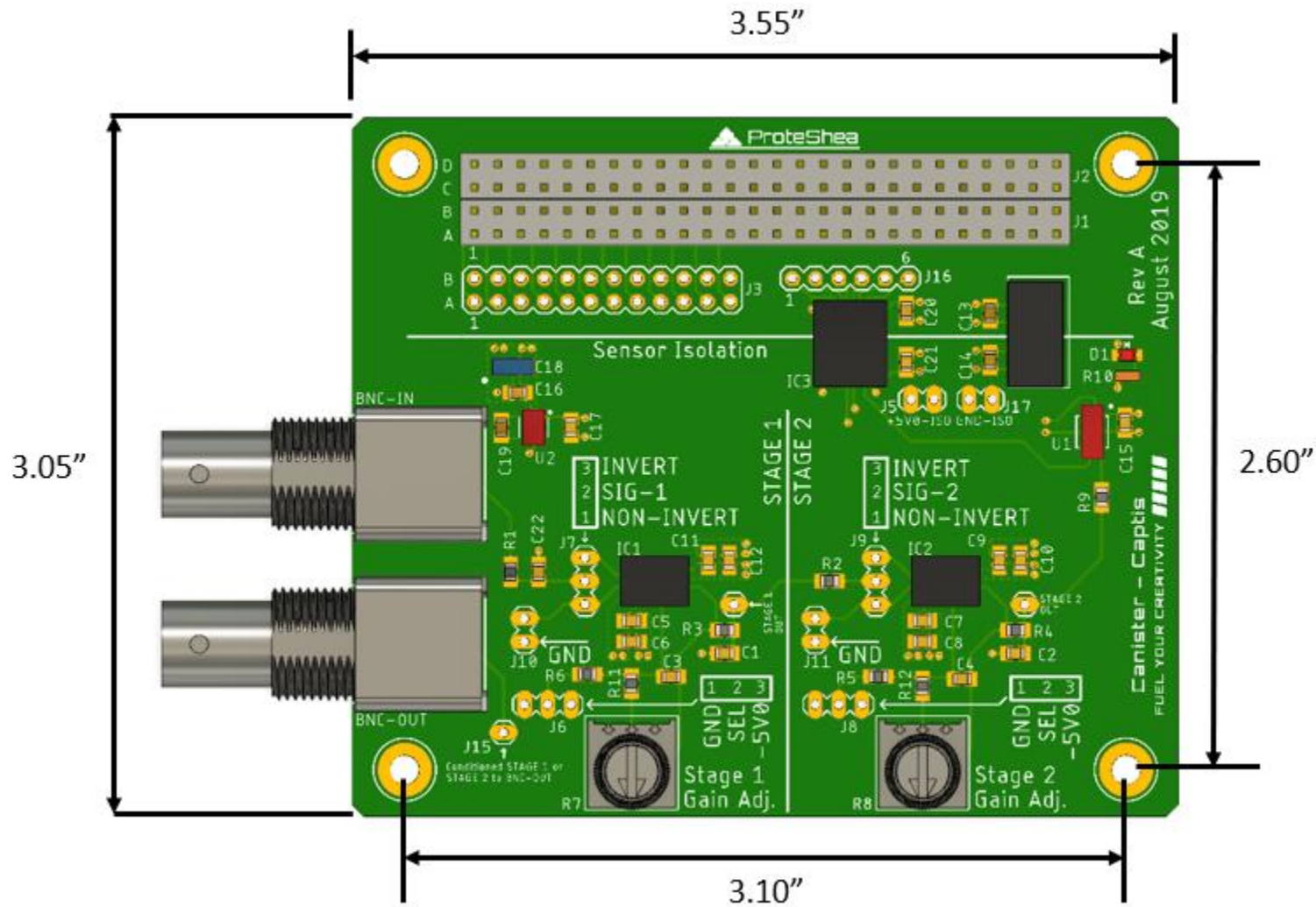


Figure 19. Captis™ Dimensions.

H. INSTALLATION

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

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



ELECTRIC SHOCK WARNING: Never use the FuelCan with a damaged AC-DC Adapter 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 Adapter 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. 20 below to wire wrap the pins of header J16 to header J3. Refer to Fig. 3 for a description of the 1-to-1 link to determine which pins on the J3 header to wire wrap to. Fig. 20 is used for reference but can be wire wrapped differently depending on user configuration and canister stack.
4. Use Fig. 21 below to correctly orientate the Canister with the Fuelcan Main Interface board or another Canister by aligning pin A1 on both boards.
5. Use two hands and apply even pressure on both sides of the Canister (areas marked in red in Fig. 22) to press into Main Interface board or another Canister board.

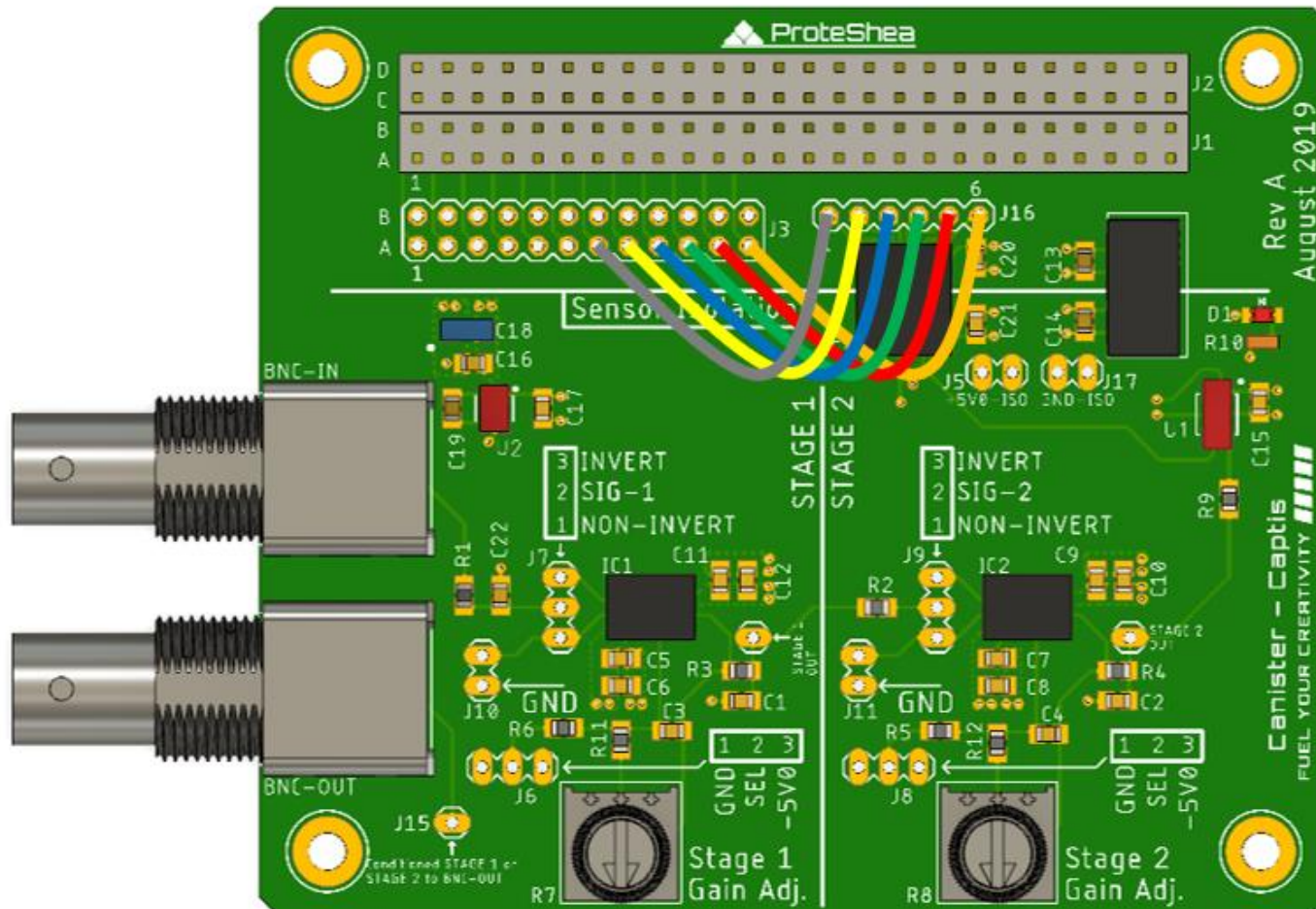


Figure 20. Wire Wrap Configuration.

Fig. 20 shows an example wire wrap configuration for connecting J16 to J3. By wire wrapping J16 to J3, the J16 signals are now routed through to the 4x26-pin connector.

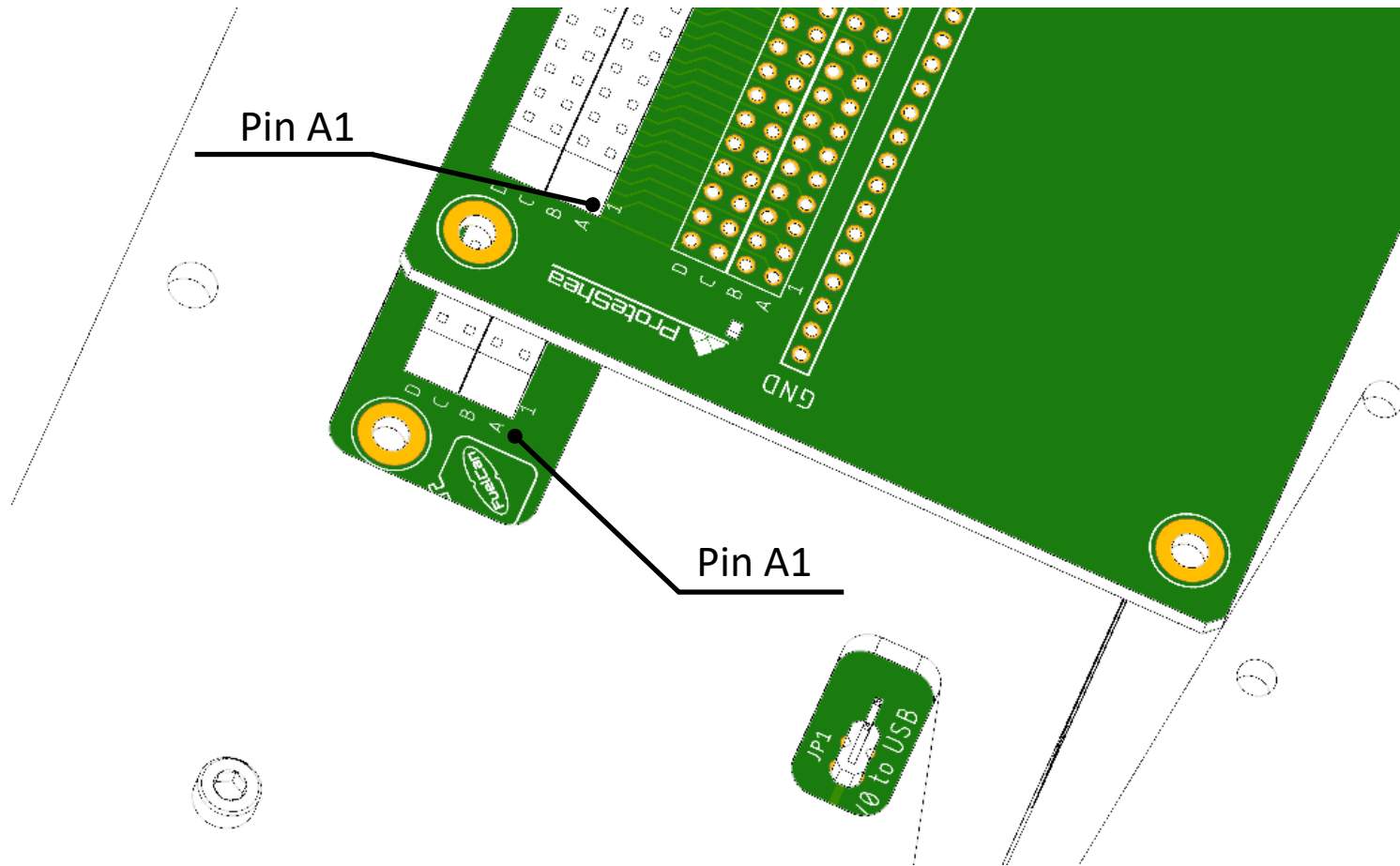


Figure 21. Proper Alignment of Canister to Main Interface Board.

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 Adapter 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's AC-DC Adapter 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. X) to pull the board vertically out of the Main Interface board.

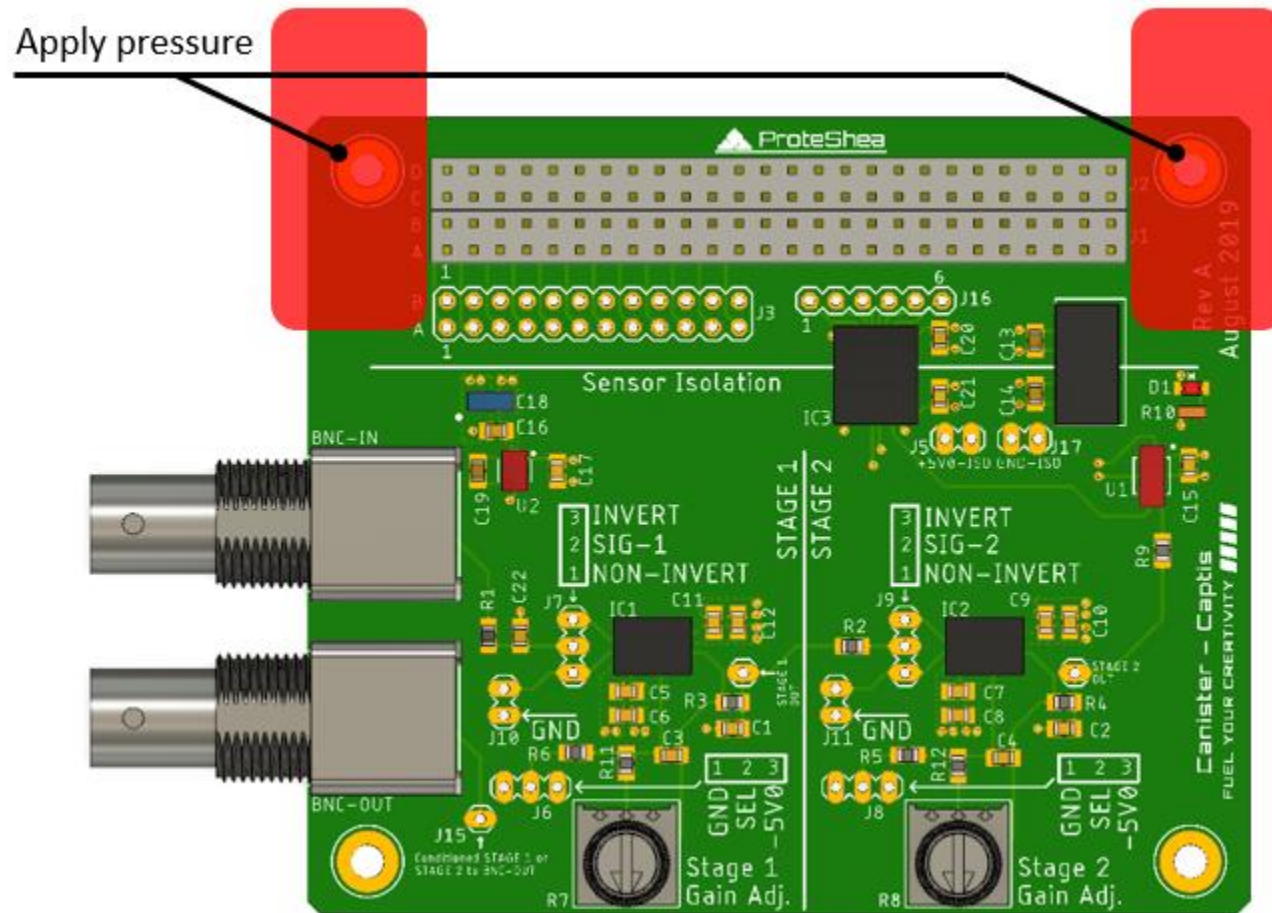


Figure 22. Areas to Apply Pressure for Installation or Removal.

J. OPERATION

Follow the steps below for operation of the Canister:



ELECTRIC SHOCK WARNING: Never use the FuelCan with a damaged AC-DC Adapter 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 Adapter 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. Use jumper wires to connect the SPI breakout header to the 1-to-1 link or from the 4x26-pin connector to a development platform (Raspberry Pi 3 or Arduino).
5. Inspect Canister and development board 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

Problem	Cause	Solution
No power to Canister	AC-DC adapter shutdown voltage rails due to circuit protection	Unplug power and check for shorts between 4x26-pin connector of Canister and development board
Power regulator is overheating	Not enough copper or vias to dissipate heat	Add small DC fan or heat sync to top of component
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)

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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

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WARRANTY INFORMATION. ProteShea warrants that the Canister accompanying this document will be free from manufacturing defects for up to 30 days from the date of purchase, subject to the terms and conditions of this Limited Warranty (“THE WARRANTY”). In the event of a warranty claim, customer shall pay for the shipping costs both to and from ProteShea. Customer assumes full liability for loss and/or damage to the Canister during the warranty claim.

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.

LIMITATION OF LIABILITY. ProteShea’s aggregate liability for any and all causes relating to the use or possession of the Canister, regardless of the form of the claim, shall be limited to the sum of \$50 US dollars, whether arising out of negligence, tort, strict liability, contract, breach of agreement, or otherwise. IN NO EVENT SHALL PROTESHEA BE LIABLE FOR – AND THE CUSTOMER

OR ANY OTHER PARTY SHALL NOT BE ENTITLED TO – CONSEQUENTIAL, COMPENSATORY, EXEMPLARY, SPECIAL, PUNITIVE, INCIDENTAL, DIRECT, OR INDIRECT DAMAGES ARISING OUT OF THE USE OR POSSESSION OF THE CANISTER, INCLUDING, WITHOUT LIMITATION, THE VALUE OF THE CONTENTS OF THE CANISTER, INJURY, LOST PROFITS OR REVENUE, LOSS OF EQUIPMENT, OR OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER OR NOT THE POSSIBILITY OF SUCH LOSSES OR DAMAGES HAS BEEN DISCLOSED TO PROTESHEA.

LIMITATION OF DAMAGES. ProteShea’s aggregate liability for any and all damages to the customer resulting from the use or possession of the Canister shall not exceed the sum of \$50 US dollars regardless of whether the claim giving rise to such damages is based upon negligence, tort, strict liability, contract, or otherwise.

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Raspberry Pi is a trademark of the Raspberry Pi Foundation.

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GOVERNING LAW, VENUE, JURISDICTION. The laws of the State of New York will govern this Agreement without regard to principles of conflicts of laws. Customer agrees that any disputes or claims that customer may have against ProteShea, which are not subject to the arbitration clause described below, will be resolved by the state and federal courts in the County of Saint Lucie, Florida. Customer hereby agrees to personal jurisdiction in the County of Saint Lucie, Florida. Customer agrees, in the event that any dispute arises with ProteShea, at least 30-days prior to filing any action or demanding arbitration, Customer will provide written notice to ProteShea of the dispute, and attempt to negotiate a written resolution of the matter that will be agreed upon by all parties involved. In any dispute, the terms of this agreement will control.

ARBITRATION. ANY AND ALL CLAIMS OR DISPUTES BETWEEN PROTESHEA AND CUSTOMER RELATING IN ANY WAY TO THESE TERMS OR THE SERVICES OR PRODUCTS (INCLUDING BUT NOT LIMITED TO THE CANISTER) PROVIDED BY PROTESHEA MUST BE RESOLVED IN BINDING ARBITRATION RATHER THAN IN COURT. IN ARBITRATION, THERE IS NO JUDGE OR JURY, AND COURT REVIEW OF AN ARBITRATION AWARD IS LIMITED. THE ARBITRATOR CAN AWARD ANY DAMAGES OR RELIEF ON YOUR INDIVIDUAL CLAIM THAT A COURT OF LAW COULD, INCLUDING INDIVIDUAL INJUNCTIVE RELIEF AND ATTORNEYS' FEES WHEN AVAILABLE UNDER THE GOVERNING LAW. ALL ARBITRATIONS WILL BE CONDUCTED ON AN INDIVIDUAL BASIS, AND THERE SHALL BE NO CLASS ACTIONS IN ARBITRATION. CUSTOMER AGREES THAT ANY ARBITRATION WILL OCCUR IN THE COUNTY OF SAINT LUCIE, FLORIDA.