

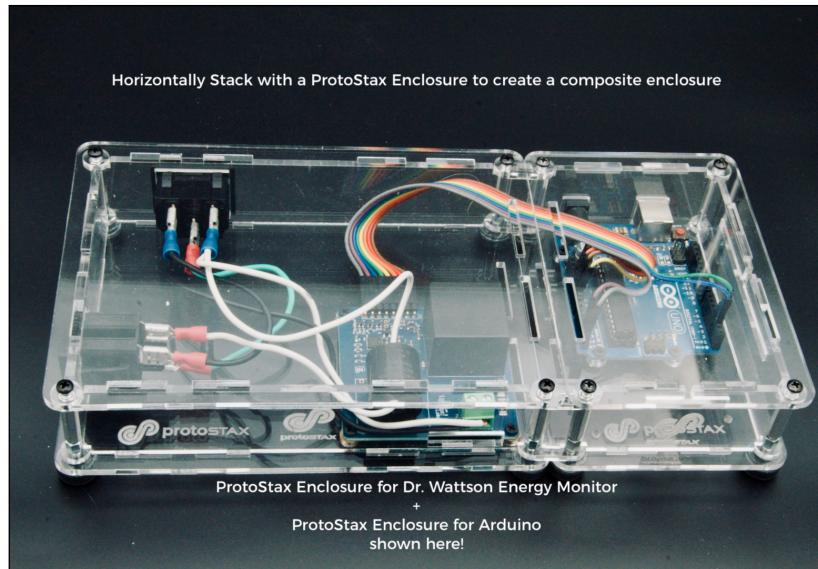
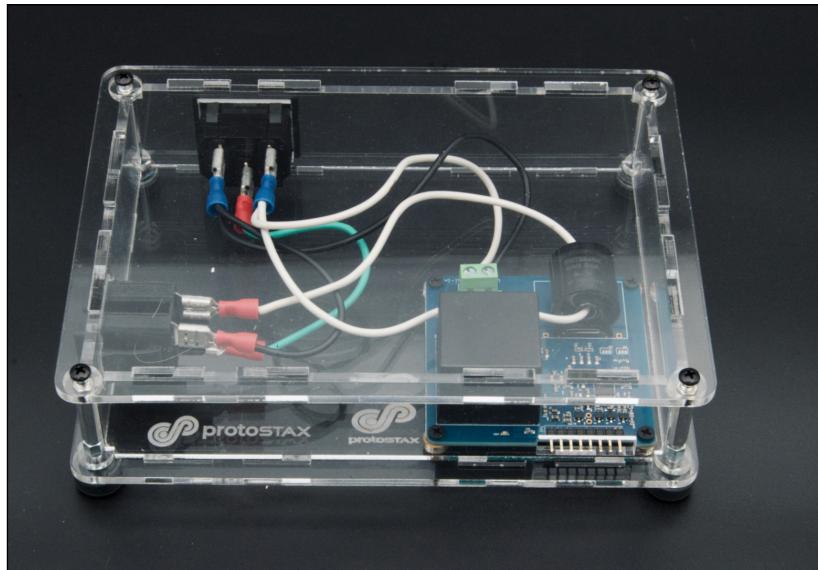
Instruction Manual

ProtoStax Enclosure for Dr. Wattson Energy Monitoring Board V2

Revision 1.0 - November 4, 2022

Author: Sridhar Rajagopal

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1.

Introduction

Thank you for purchasing the Dr. Wattson Energy Monitoring Board and ProtoStax Enclosure for Dr. Wattson Energy Monitor! You can now easily incorporate quality AC power measurements and energy monitoring into your next Arduino or Raspberry Pi project.

This manual is to help you get started with the necessary setup. This document will tell you how to your Dr. Wattson with the ProtoStax Enclosure for Dr. Wattson Energy Monitor, which provides a safe platform for dealing with high voltage components while still being able to access the energy data easily.

1.1.

Disclaimer



Dr. Wattson is designed to be safe with built-in isolation using current and voltage transformers, and also has an enclosure available to shield you from high voltages. You will, however, still need to do the wiring for your particular application. Please use common sense and caution, and if necessary, please get help from someone knowledgeable and qualified!

Incorrect or improper handling could result in:

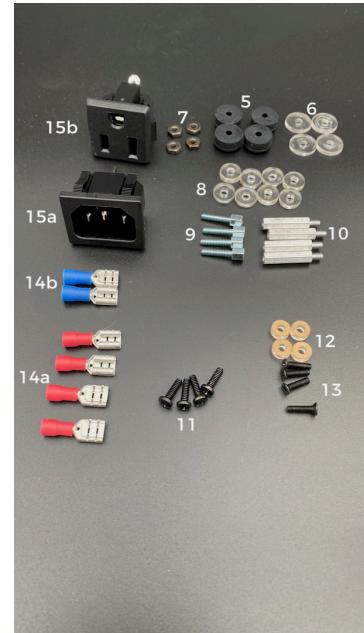
- Serious injuries or death
- Physical damage of the product
- Creating dangerous hazards

Upbeat Labs (and Sridhar Rajagopal) cannot be held liable or responsible, and will not accept any type of liability in any event, in case of injury or even death by building and/or using or misusing this information. By accessing, reading, and/or printing the instructions presented here, you agree to be solely responsible as stated in the above disclaimer and exempt Upbeat Labs and/or Sridhar Rajagopal from any criminal and/or liability suit.

Safety is a primary concern with high voltage circuits! Do not attempt unless you know what you are doing and take the necessary precautions!

2.

Parts List



ID	Item	Quantity	ID	Item	Quantity
1	Base Plate	1	9	Lower Vertical Bracing Element	4
2	Top Plate	1	10	Upper Vertical Bracing Element	4
3a	Long Side Wall 1	1	11	Top Screw	4
3b	Long Side Wall 2	1	12	PCB Spacer	4
4a	Short Side Wall 1	1	13	PCB Mounting Screw	4
4b	Short Side Wall 2	1	14a	Red Spade Connector (22 - 16 AWG) (10A 300V)	4
5	Rubber Feet	4	14b	Blue Spade Connector (16-14 AWG) (15A 300V)	2
6	Washers for Rubber Feet	4	15a	IEC Power Inlet (15A 250VAC)	1
7	Hex Nuts	4	15b	AC Power Outlet (15A 125VAC)	1
8	Vertical Bracing Spacers	8			

Note that the acrylic enclosure pieces come with a protective layer that should be peeled off.

3.

Tools Needed

You will need the following tools to assemble Dr. Wattson in your enclosure.

1. #1 Phillips screwdriver
2. Crimper to crimp the spade connectors to your wire (such as this one <https://www.homedepot.com/p/Gardner-Bender-Terminal-and-Crimping-Tool-Kit-GS-67K/202518592>)
3. Wiring: 16 gauge or better recommended. Please select suitable wiring gauge for your application given the maximum load as per your design
4. Wire cutter/stripper to cut and strip the appropriate gauge wiring (the crimping tool above also has wire strippers)

4.

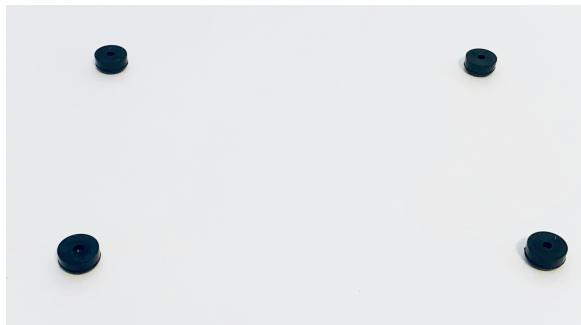
Assembly Instructions

4.1.

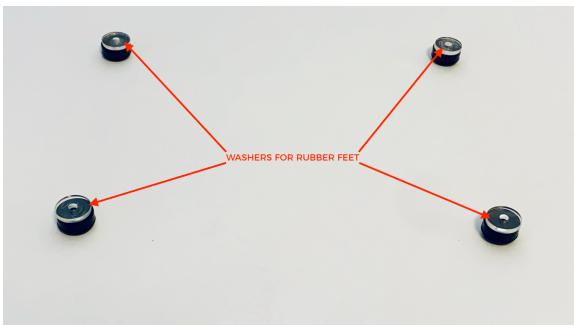
Step 1 - Platform Configuration



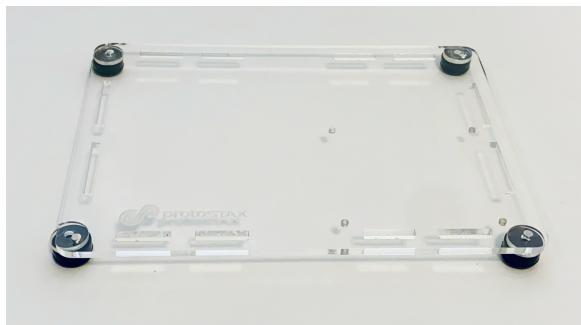
1. Insert Hex Nut (7) into Rubber Foot (5)



2. Turn Rubber Feet over



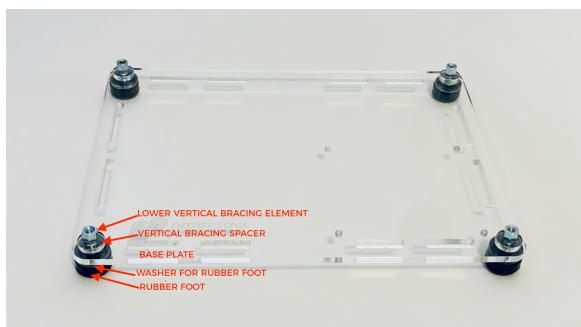
3. Place Washers for Rubber Feet (6) over them



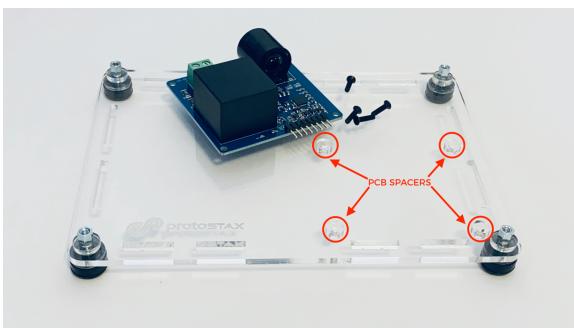
4. Base Plate (1) goes over



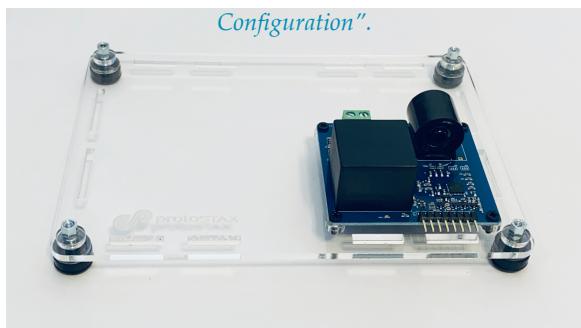
5. Prepare Vertical Bracing Spacers(8) and Lower Vertical Bracing Elements (9)



6. Screw lower vertical bracing elements with their spacers into hex nuts below. This is "Platform Configuration".



7. Use PCB spacers (12) and PCB Mounting screws (13)

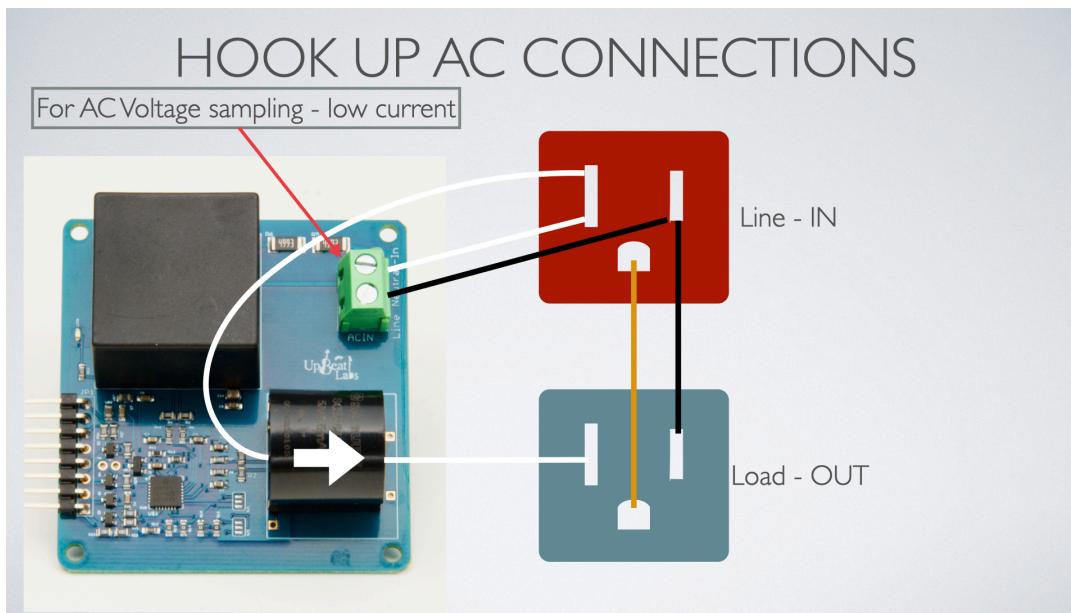


8. Dr. Wattson mounted in Platform Configuration!

4.2.

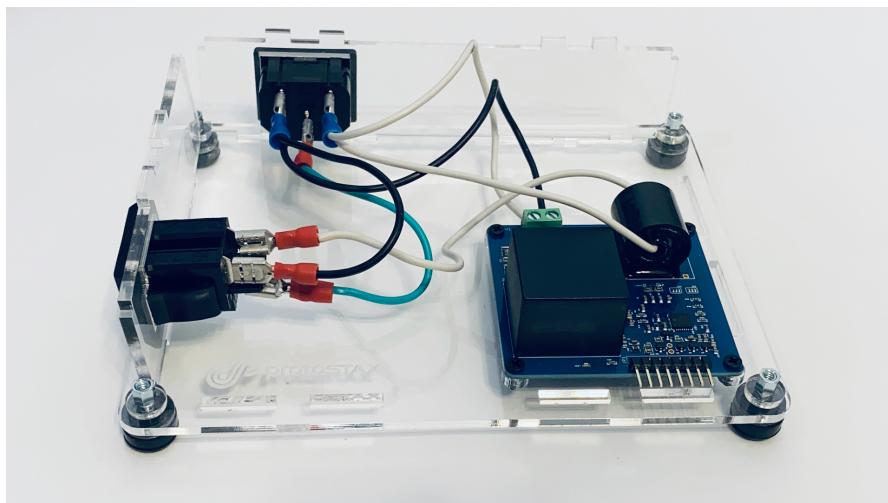
Step 2 - High Voltage Wiring

Refer to the Dr. Wattson User Manual for more details about the high-voltage wiring. The wiring diagram is repeated here for convenience:



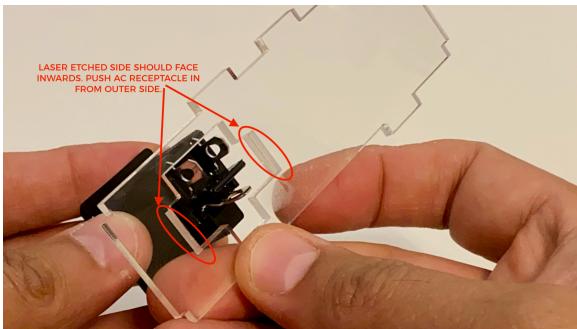
We have provided snap-in panel mount IEC (for LINE-IN) AC Power Inlet and NEMA 5-15R AC Power Outlet (for OUT) receptacles, as well as spade connectors (4x red and 2x blue) for your convenience. The blue spade connectors are bigger gauge (16-14 AWG) and can therefore be used for the LINE-IN load and neutral which each have **two** wires coming out. You can use the smaller red spade connectors (22 - 16 AWG) for the other spade connectors (LOAD-OUT Load and Neutral and Earth/Ground connectors). Please ensure that the connectors and receptacles satisfy the ratings for your application. Also, note the correct orientation of the Neutral wire through the Current Transformer's core - this is essential for correct Energy Import/Export calculations (they will be reversed otherwise).

Screw the ends of the extra wires from the IEC receptacle into the AC IN terminal connectors on Dr .Wattson. The final result will look like the following (and we'll show you how to get there!):

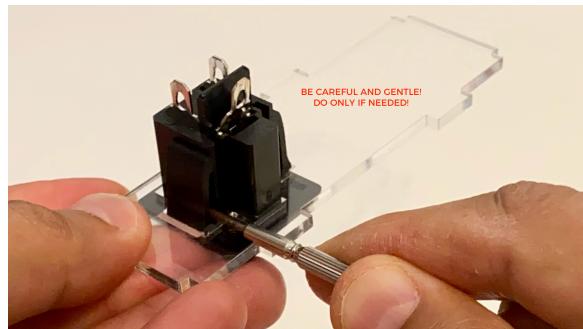


4.3.

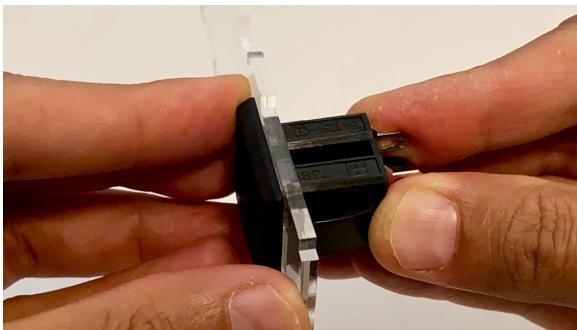
Step 3 - Prepare AC Outlet



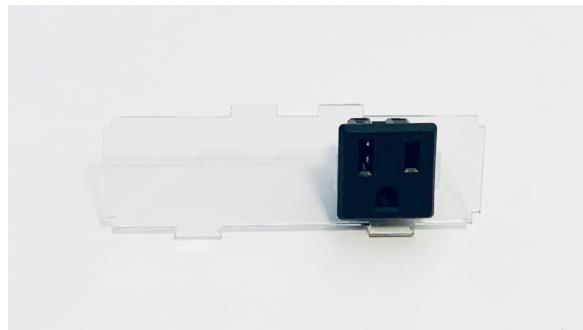
1. Note that etched portion of AC panel cutout faces inwards



2. Gently use a small screwdriver to click the side tabs in place, **only if needed**. Be very careful that you don't snap the acrylic! Acrylic is strong but brittle and you should be careful not to apply too much pressure



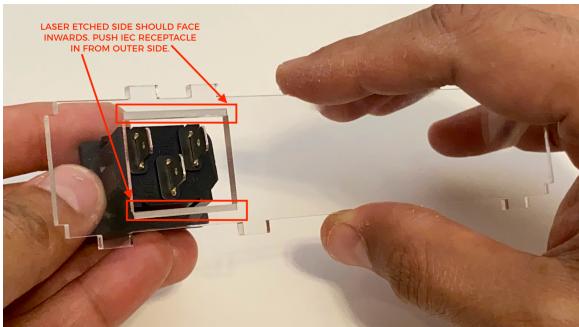
3. Check that the AC Outlet is firmly seated



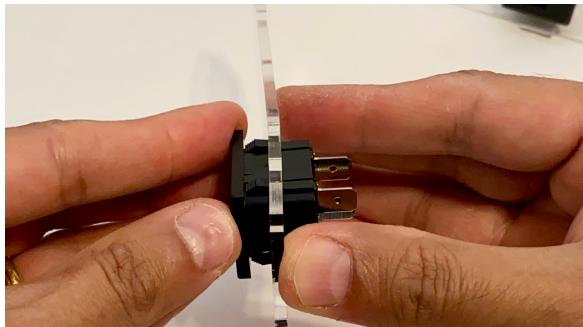
4. End result

4.4.

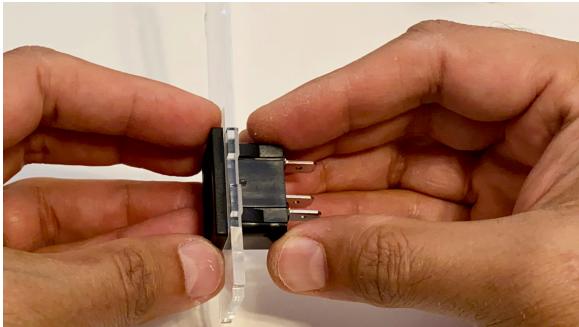
Step 4 - Prepare IEC AC Inlet



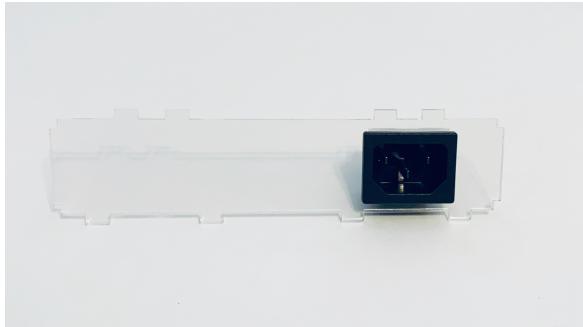
1. Note that etched portion of IEC panel cutout faces inwards



2. Push in gently! Be careful not to snap the acrylic!
Acrylic is strong but brittle and you should be careful
not to apply too much pressure



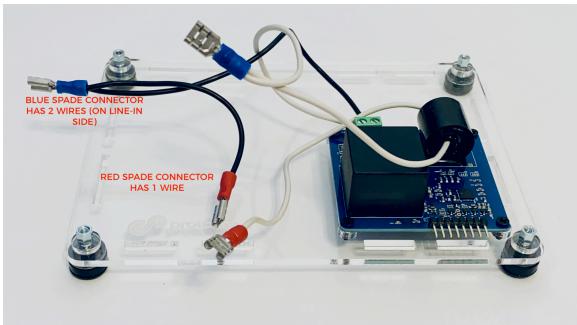
3. Check that the IEC Inlet is firmly seated



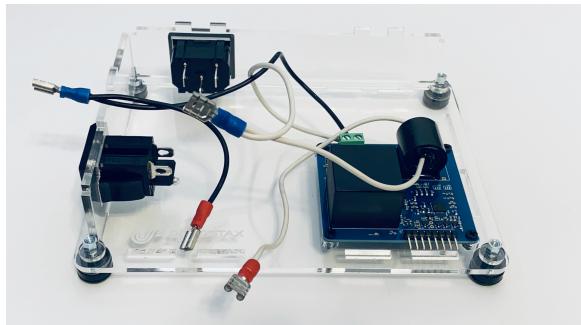
4. End result

4.5.

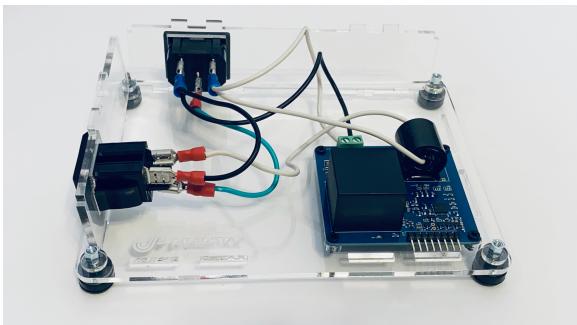
Put Everything Together



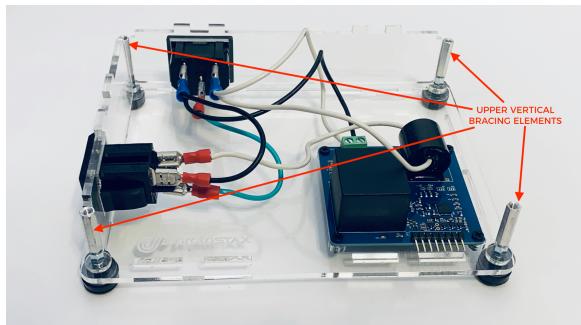
1. Finish wiring as per High Voltage wiring instructions



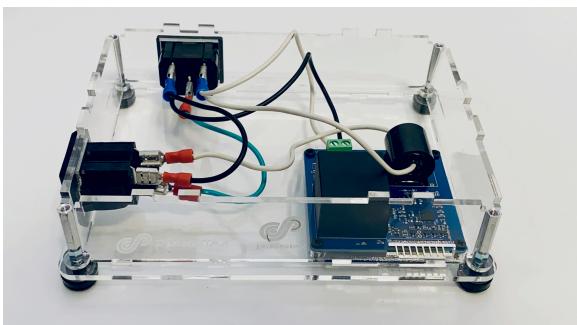
2. Insert side walls with IEC AC Inlet and AC Power Outlet into wall slots



3. Hook up the spade connectors of the wiring to the appropriate receptacles



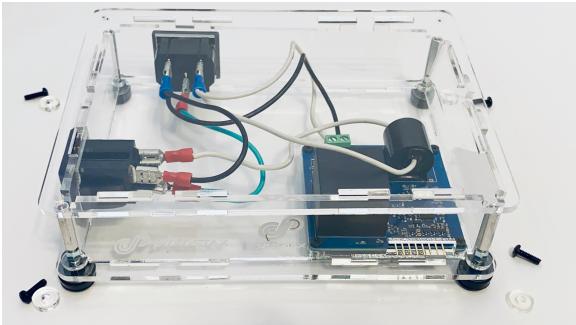
4. Add the Upper Vertical Bracing Elements



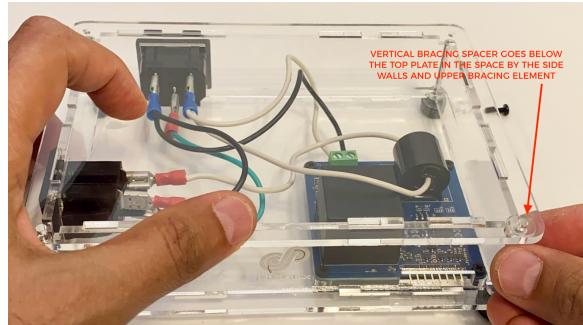
5. Add the remaining side walls



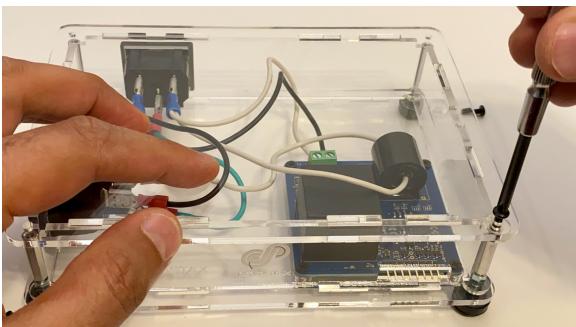
6. Line the Top Plate (2) up with the tabs of the side walls fitting into the wall slots. Finesse this step, moving the side walls as appropriate. Avoid excessive pressure which can crack the acrylic, which is strong, but can be brittle



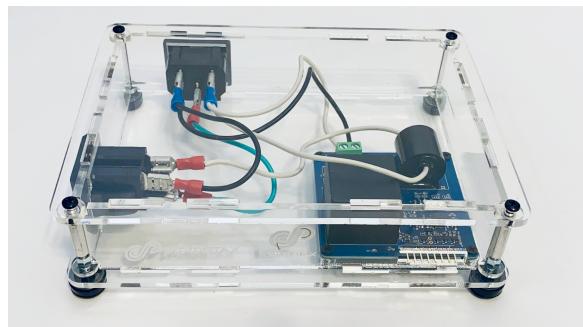
7. Prepare the remaining Vertical Bracing Spacers (8) and Top Screws (11)



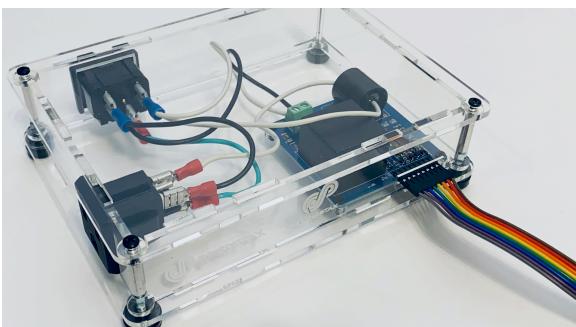
8. The Vertical Bracing Spacer goes in the space below the Top Plate and the Side Walls



9. Screw in the Top Screws (11)



10. All done!



11. Cutout allows access to Dr. Wattson's Headers to interface with your SBC/MCU of choice!

At this point, you're all set! You can interface your Dr. Wattson easily with your micro-controller (MCU) or single-board computer (SBC) of choice, while having a safe environment for your high-voltage load. Plug in your load, and measure away! Let us know what interesting applications you come up with! 😊

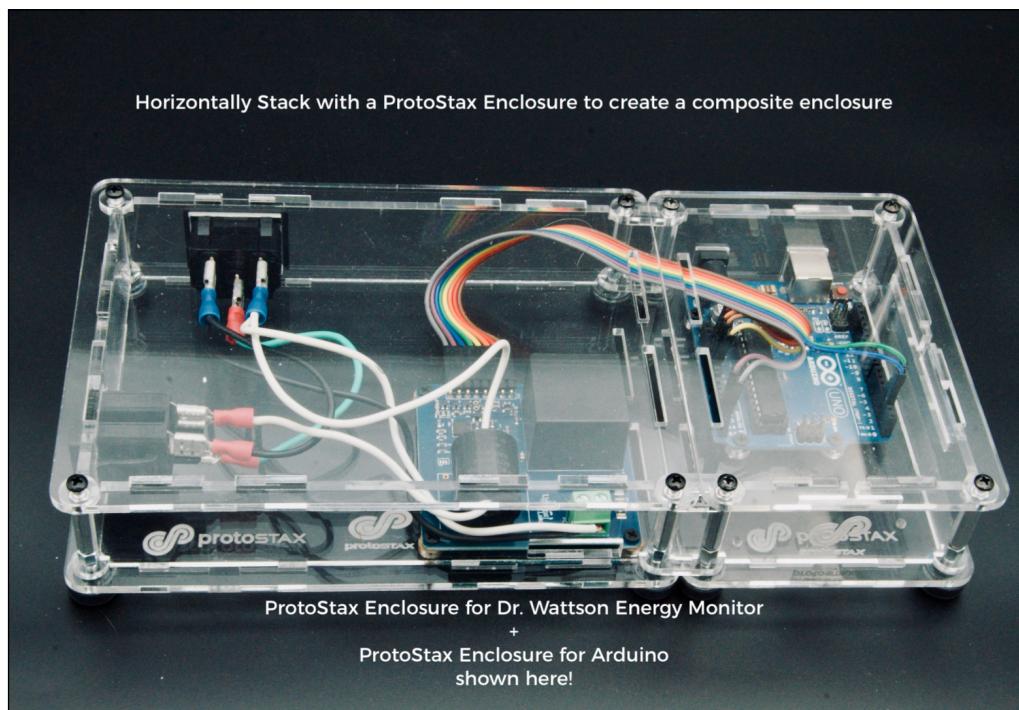
ProtoStax Enclosures are stackable, modular and extensible, however. This allows you to have a composite enclosure that also includes your Arduino, Raspberry Pi or other breadboard-friendly MCUs/SBCs. In the next chapter(s), we'll show you how!

5. Stacking with other ProtoStax Enclosures

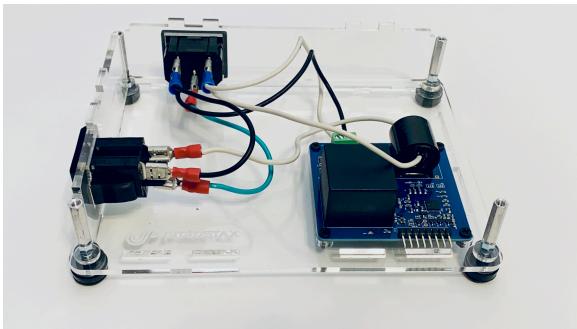
ProtoStax Enclosures are Stackable. They can be stacked vertically, or side-by-side (aka horizontally) using the [ProtoStax Horizontal Stacking Kit](#). This means that you can add a suitable ProtoStax Enclosure to form a composite enclosure that also includes your MCU / SBC of choice. You can choose from one of the following ProtoStax Enclosures:

1. [ProtoStax Enclosure for Arduino](#)
2. [ProtoStax Enclosure for Breadboard/Custom Board](#) (use with any breadboard-friendly MCU. Fits a half-size breadboard)
3. [ProtoStax Enclosure for Raspberry Pi B+/4B](#)
4. [ProtoStax Enclosure for Raspberry Pi Zero](#)
5. [ProtoStax Enclosure for Raspberry Pi A+](#)

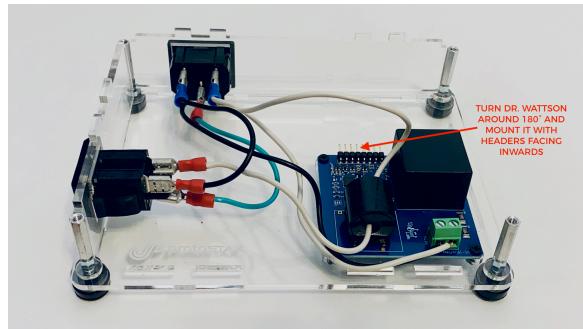
In the example below, we use a [ProtoStax Enclosure for Arduino](#). The steps assume you have already completed your [ProtoStax Enclosure for Dr. Wattson Energy Monitor](#), and show you how to backtrack a little bit and make a composite enclosure which includes [ProtoStax Enclosure for Arduino](#).



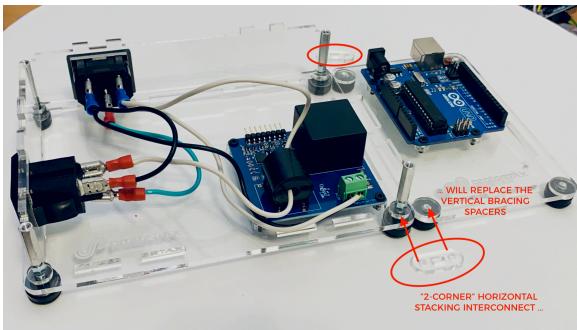
You can also refer to the [ProtoStax User Manual](#) for additional details on stacking and overall usage.



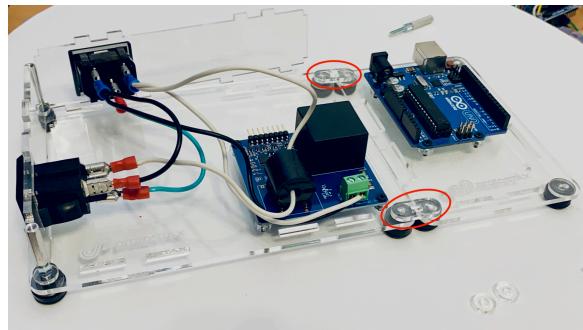
1. Remove Top Plate (2) and 2 side walls



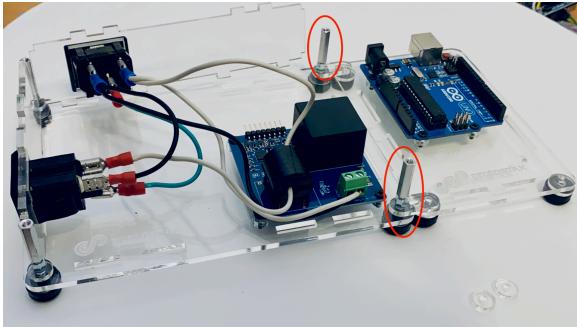
2. Turn Dr. Wattson around 180° and mount it - we no longer need external access to its headers



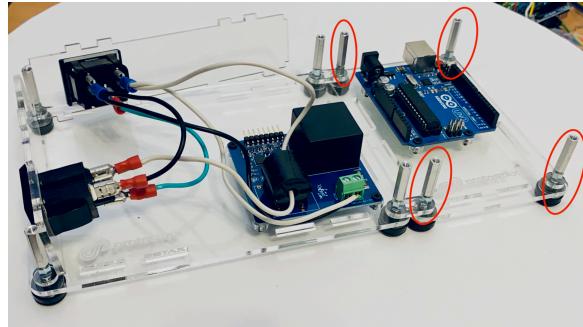
3. Place ProtoStax enclosure to be used beside it, with Base Plate and Bottom Feet with Washers.



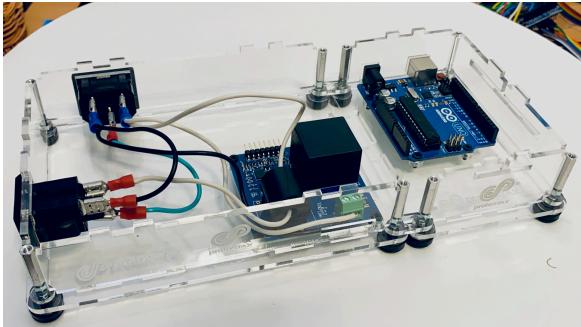
4. Replace the Vertical Bracing Spacers shown with "2-corner" Horizontal Stacking Interconnect from the Horizontal Stacking Kit



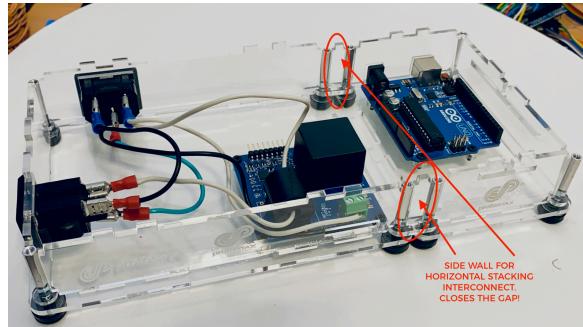
5. Screw the lower and upper vertical bracing elements back again



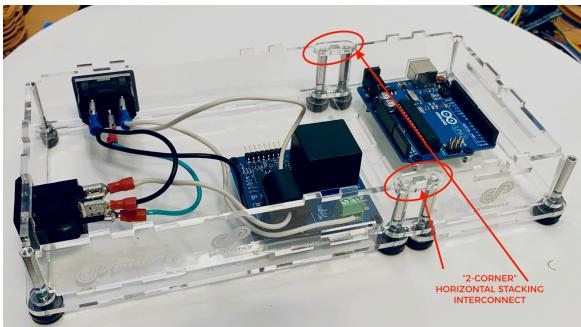
6. Attach the remaining Vertical Bracing spacers and Lower and Upper Vertical Bracing Elements to the ProtoStax Enclosure



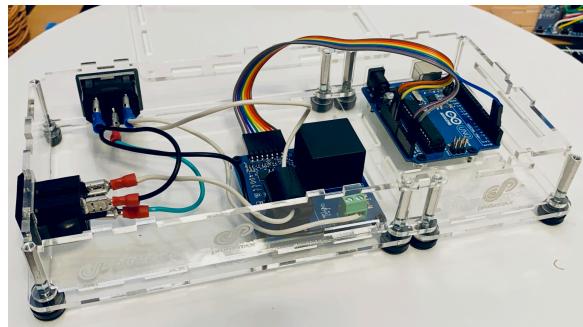
7. Add the desired side walls. Here we omit the internal side walls between the two ProtoStax enclosures



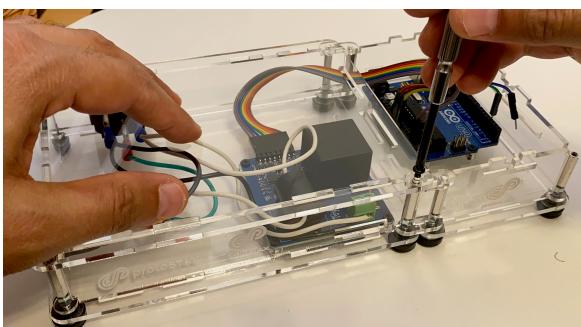
8. Add the Side Walls for Horizontal Stacking Interconnects - these close the gap between the enclosures



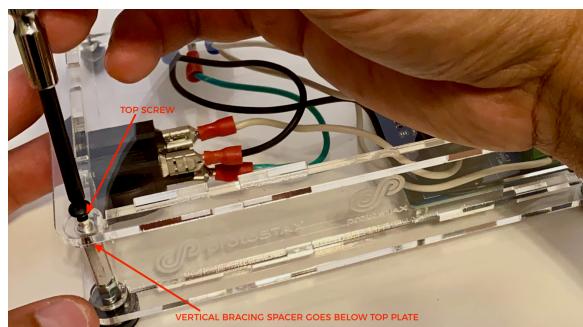
9. Add "2-corner" Horizontal Stacking interconnects at the top to complete tying together the two enclosures



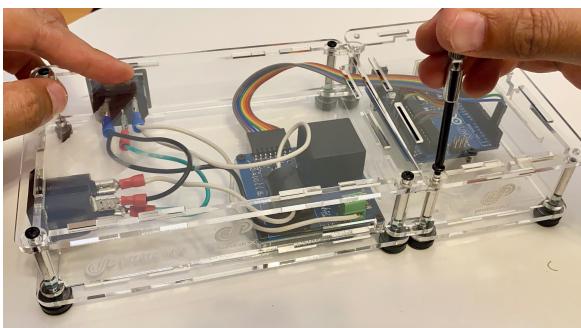
10. Finish the wiring between Dr. Wattson and the board (Arduino shown here)*refer to Dr. Wattson User Manual



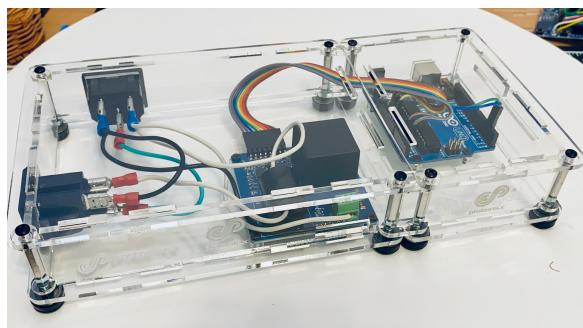
11. Close the top plate and fix with top screws (11)



12. Use Vertical Bracing Spacers(8) and Top Screws(11) on the remaining sides



13. Repeat the steps to close up the "ProtoStax Enclosure for Arduino" side



14. Here is the finished composite enclosure! Get ready to code your masterpiece! 😊

6.

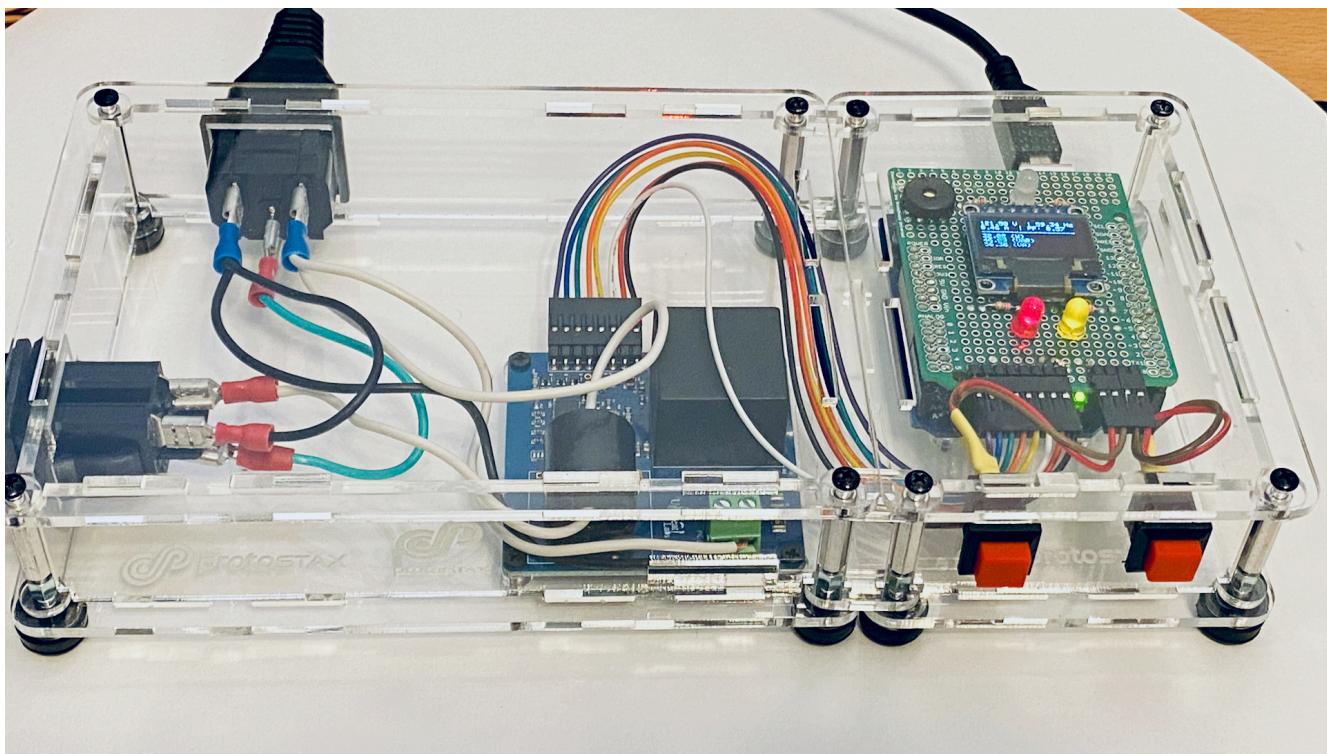
ProtoStax Extension Kits

ProtoStax Enclosures are also extensible - it is easy to add peripherals like displays, buttons, sensors, etc to your enclosures using Extension Kits - simply replace an existing top plate or side wall with another piece from the Extension Kit that has additional cutouts and components required.

In the example below, we have used the [ProtoStax Kit for Momentary Push Button Switches](#) to add buttons that can be used, for example, to change display settings. This example has a custom prototyping shield with an 128x64 OLED display, LEDs for status, ZCD and EVENT notifications, an 8-pin connector to facilitate hooking up to Dr. Wattson, and 2 2-pin connectors for the momentary push button switches. There is also a piezo speaker for audible alerts. ProtoStax Enclosures have ample room inside with 1.2 inches of clearance - plenty of room for a Shield or HAT to use with your Arduino/Raspberry Pi/other board.

The momentary push button switches here provide a means of user input that can be used for example, to change display settings, or start/stop energy accumulation, etc. These are also conveniently incorporated into the enclosure allowing for a robust and user-friendly design. Adding the switches is easy - simply swap out the existing side wall and replace with the one from the kit!

Check out other [ProtoStax Extension Kits](#) that you could utilize in your setup.



7.

Final Thoughts

Dr. Wattson - your energy monitoring building block for Arduino, Raspberry Pi and other Maker-friendly MCUs/SBCs!

We would love to hear about how you are using Dr. Wattson, as well as stories and links to your own projects! If you have any questions, comments or suggestions, please get in touch with us! If there is anything we can do to improve Dr. Wattson, its libraries, the enclosure or the guides / user manuals, please let us know!

Follow/Contact Us

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YouTube - [@protostax](#), [@sridharajagopal](#)

TikTok - [@protostax](#)

Email - support@upbeatlabs.com, support@protostax.com

Please use the following hashtags to tag posts - #drwattson #protostax

Get the libraries, code samples and documentation:

Dr. Wattson - <https://github.com/upbeatlabs>

ProtoStax - <https://github.com/protostax>

Get Dr. Wattson!

<https://www.protostax.com/products/dr-wattson-energy-monitoring-board-v2>

Get ProtoStax Enclosure for Dr. Wattson Energy Monitor!

<https://www.protostax.com/products/protostax-enclosure-for-dr-wattson-energy-monitor>

8.

Appendix: References

8.1.

Datasheets:

Qualtek 738W-X2/03 - <https://qualtekusa.com/wp-content/uploads/specsheets/738wx203.pdf>

Qualtek 701W-X2/04 - <https://qualtekusa.com/wp-content/uploads/specsheets/701wx204.pdf>

Blue Quick slide spade connectors (female) - GQF-B25V - <https://www.greenlitecable.com/resources/catalog/page22.pdf>

Red Quick slide spade connectors (female) - GQF-R25V - <https://www.greenlitecable.com/resources/catalog/page22.pdf>

8.2.

Documents

Dr. Wattson User Manual - <https://github.com/upbeatlabs/drwattson/blob/master/DrWattsonUserManual.pdf>