

WARNING: the following instructions are only to be performed by personnel with thorough awareness of electrical safety, especially the Heater modifications. No warranty is made regarding the safety of performing these steps and readers are warned that if they decide to modify any equipment that will be energized, that they do so at their own risk. The providers of this document are not responsible for, and expressly disclaims all liability for, damages of any kind or personal injuries or death arising out of use, reference to, or reliance on any information contained within this document.

Materials

- **GFCI** Auto Reset Inline GFCI Replacement Plug Assembly 15 Amp 2 Wires 2-Prongs NEMA 1-15P Non-Grounding <https://www.amazon.com/gp/product/B07P18FY72/>
- **Relay** BEM-14840DA 3-32V DC to 24-480V AC 40A Output Single Phase SSR Solid State Relay
<https://www.amazon.com/BEM-14840DA-3-32V-24-480V-Output-Single/dp/B00E1LC1VK>
- **Heater** Electric Heater for Home and Office Ceramic Small Heater with Thermostat, 750W/1500W
<https://www.amazon.com/andily-Heater-Electric-Ceramic-Thermostat/dp/B07DX1L64X>
- Bluetooth humidity/temperature monitor
<https://www.amazon.com/Govee-Temperature-Humidity-Notification-Monitor/dp/B07Y36FWTT>
- **Resistor** 100kOhm thru-hole resistor
- **Connector** Long small-gauge wires with pin socket connectors soldered on from breadboard jumper sockets (e.g. such as
<https://www.amazon.com/Elegoo-EL-CP-004-Multicolored-Breadboard-arduino/dp/B01EV70C78>)
- **Controller** Raspberry Pi, Arduino or other programmable device with at least one logic output and ability to read I2C or one-wire devices
- **Sensor** Temperature sensor such as
<https://www.amazon.com/Aideepen-Digital-Temperature-Humidity-Replace/dp/B01IBBFQF0> (I2C) or
<https://www.amazon.com/HiLetgo-DS18B20-Temperature-Stainless-Waterproof/dp/B00M1PM55K> (1-wire) - beware of thermal time constant with either of these sensors and be sure to measure response time to a transient temperature change

GFCI steps

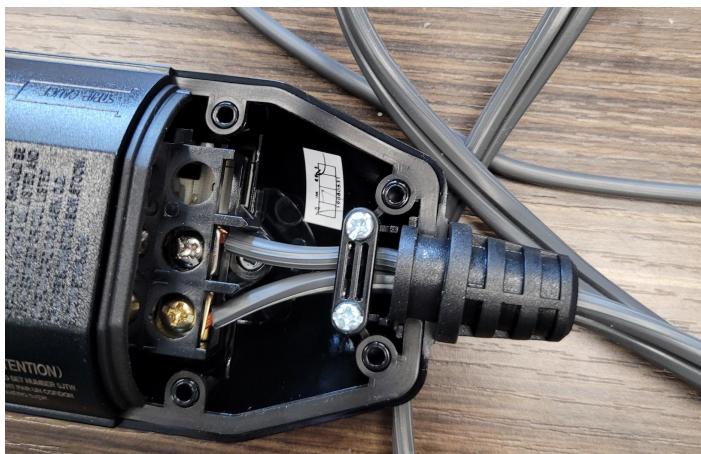
1. Take the power cable to the space heater and identify the line and neutral wires. The neutral wire will go to the wider plug, while the live wire will generally have text printed onto the wire. Cut off the end, ensuring you can identify the live side later.



2. Use the 16AWG-2 wire rubber grommet and place over the cut wire, shorter end towards the cut. Strip $\frac{1}{2}$ " insulation from the cut ends.



3. Place the live wire into the L slot, and the neutral wire into the N slot and secure both. Place the grommet into the space provided for it and screw down the cable relief securely, then place the cover and screw in place securely.



4. Power the device and confirm the test button cuts power.

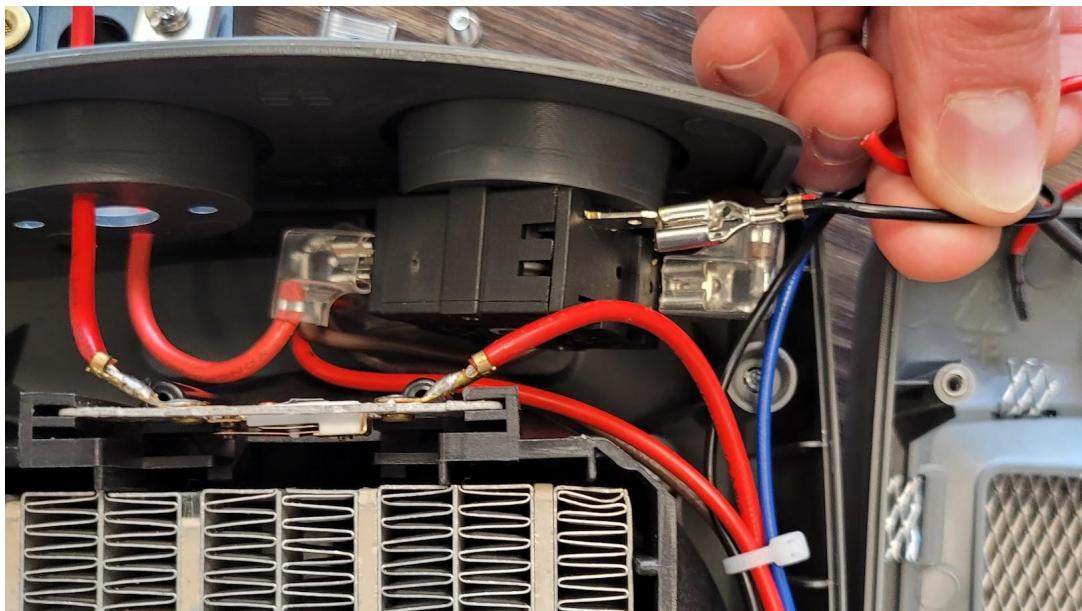
Heater control steps

1. Pull off the friction-mounted temperature adjust dial and unscrew the thermostat underneath.
2. Place the **Heater** on its front and unscrew the four main screws, then flip over and flip off the front cover (so it remains attached on one side by the case sticker).
3. Detach the two red thermostat wires and clip off the attachment crimps from each. One wire is routed from wall power and shall be called the upstream side. The upstream side

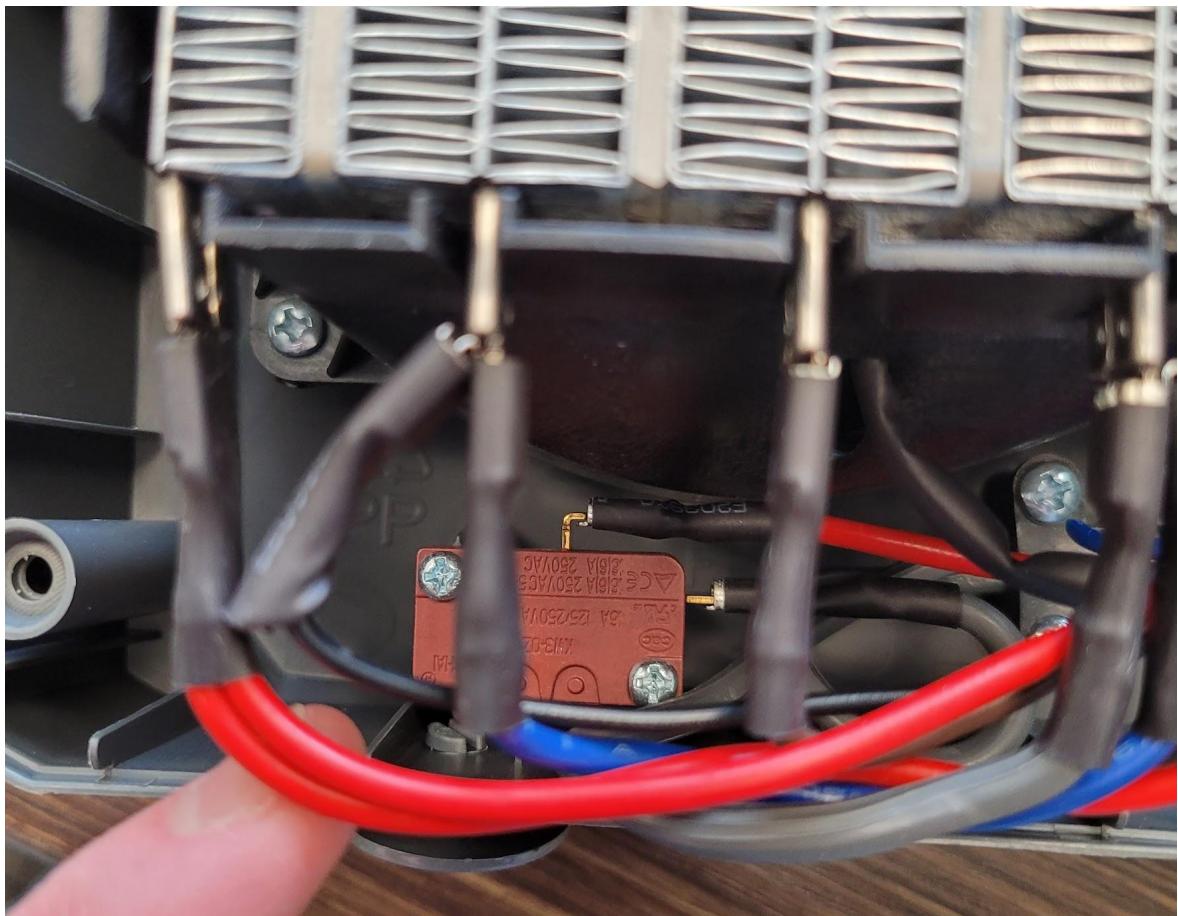
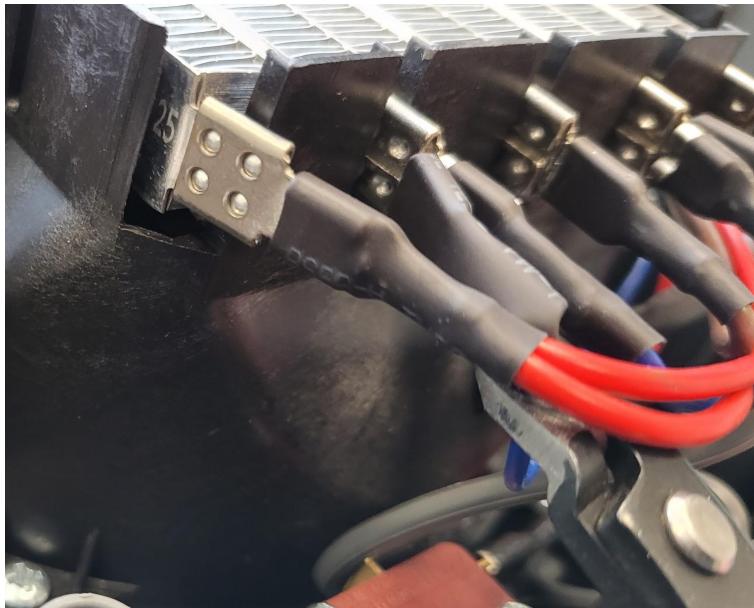
and the downstream side wires should be routed out through the thermostat holes.



4. Disconnect the wire for the neon lamp at the switch assembly (there is a press-down tab near the crimp which may be hidden underneath heatshrink tubing that enables easy slide-off of this connector).



5. Find the wire for the fan where it inserts next to a blue wire for the neon lamp indicator - cut the blue wire next to where it inserts at the base of the heater core but do not cut any other wire. Pull the blue wire through the cable ties and remove the neon bulb. Cut the fan black wire going into the neon bulb as close to the neon bulb as possible and re-route this black wire to exit the thermostat hole nearest the upstream side wire. Discard the neon bulb and wires still connected to it. The first picture below shows a wire clipper placed up near the boot of the heatshrink tubing to clip only the blue wire.



6. Reattach the cover, flip over and screw in the four screws (this can be done later if one takes care to ensure the assembly does not come apart).
7. Strip 1" from the ends of the upstream, downstream and black fan wire. Twist the fan balck wire together with the red upstream wire and bend over at midpoint (like a J shape

or umbrella handle), then insert a screw/clip from the relay and screw into the controlled side of the relay. Twist the red downstream, bend over like the upstream wire, and insert the other screw+clip from the relay and screw into the other hole of the controlled side of



the relay.

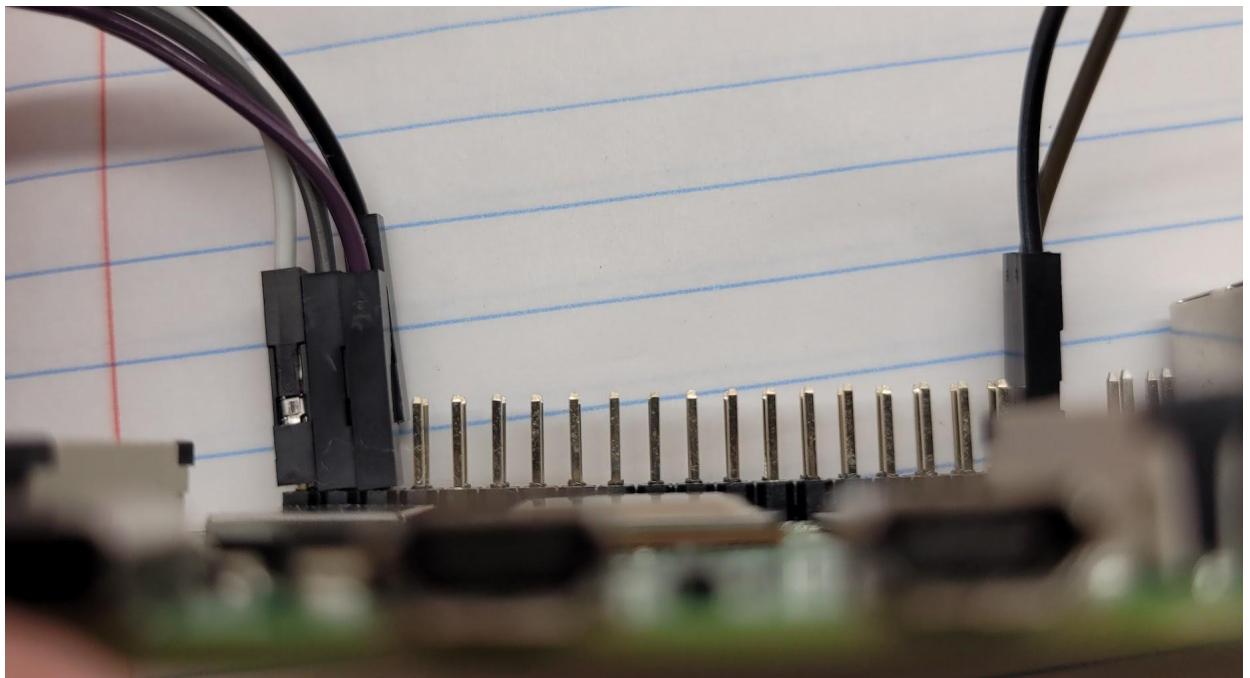
8. Partially unscrew the control side of the **Relay** and insert the **Resistor** into one side, bend the excess $\frac{1}{4}$ " approximately 90 degrees toward the other side, then repeat on the other side to partially secure the resistor around the two screw posts. Strip $\frac{3}{4}$ " insulation from each of the connector wires and insert next to the resistor and screw in place on

both sides.



9. Insert the ground side of the **Connector** post onto a ground pin on the **Controller** (e.g. pin 39 on the Raspberry Pi 40-pin header) and the signal wires onto a GPIO pin (e.g. pin

40 of the same header).



10. Insert the **Sensor** into appropriate pins of the **Controller** (e.g. pins 1,3,5,6 for I2C 3.3V, SDA, SCL, GND).
11. Connect to the controller and test both the sensor (not covered here) and relay can be accessed (e.g. “gpio mode 21 write”, “gpio toggle 21” on the Raspberry pi but ensure it is unpowered or switched back to an input when done).