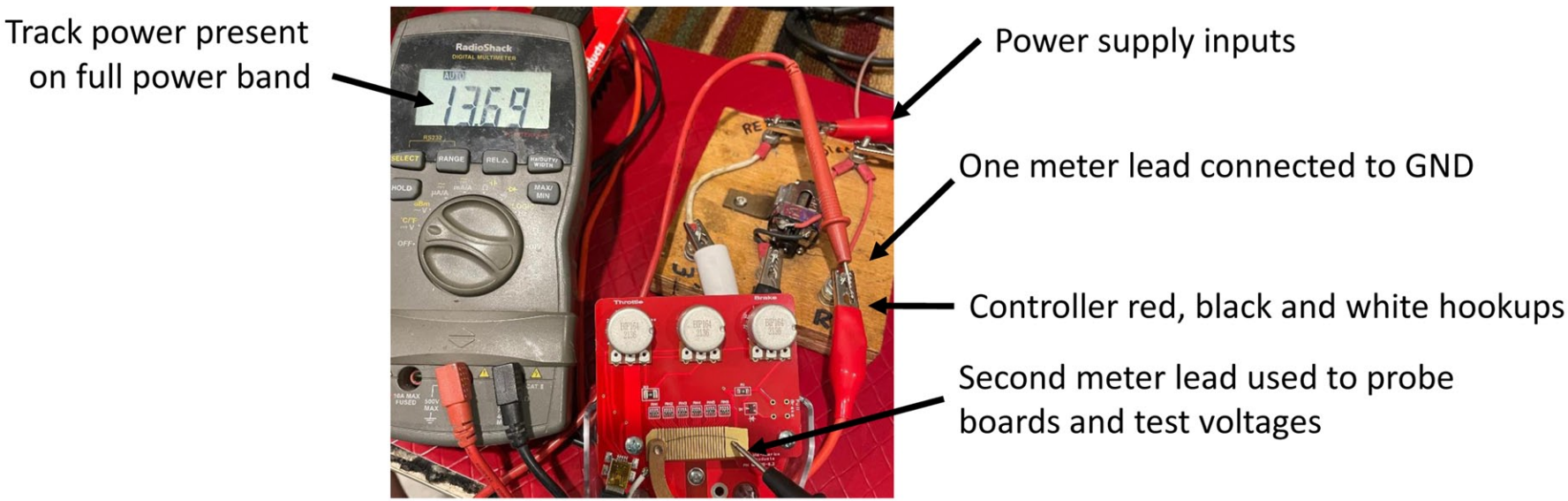
Troubleshooting Overview

- Unless told otherwise, wiper board troubleshooting is best done with the controller powered
- If you have a test fixture, wire the controller up to the fixture and apply power as shown in Figure 1.
- If you only have a power supply, connect the controller's RED input to the power supply's negative (-) output. Connect the controller's WHITE input to the power supply's positive (+) output. Leave the controller's BLACK wire disconnected.
- The power supply's negative (-) is the ground (GND) connection for the controller. Most voltage measurements will be made with respect to this point, GND. Connect one lead of your voltmeter to GND, the other to the power supply's positive (+) output and verify that your meter is displaying positive voltage (nominally +12 to +14 volts) If your voltage reads negative, just swap your meter leads. Now you are ready to begin troubleshooting.

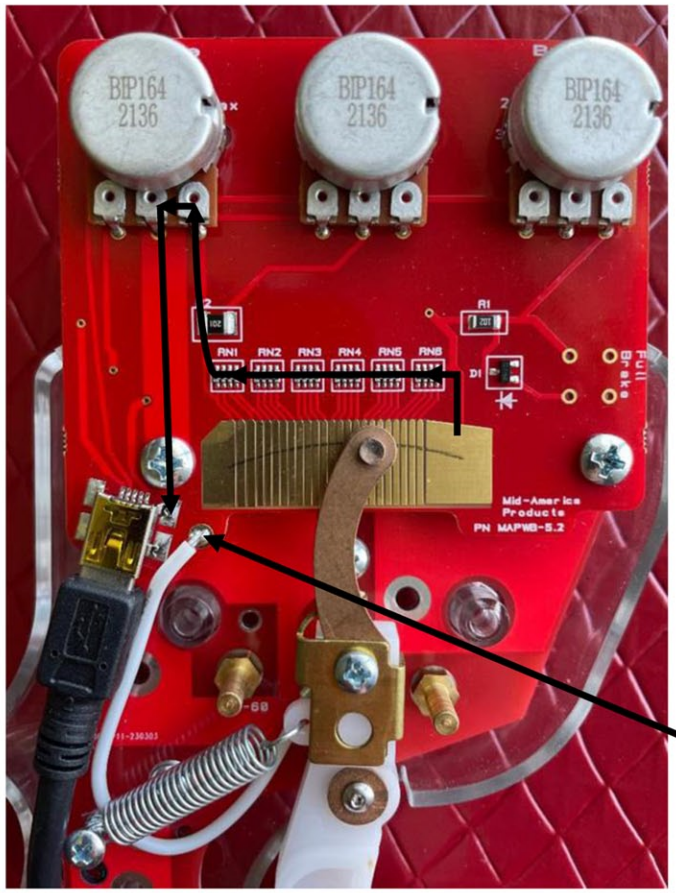
Figure 1. Controller Wired up for Troubleshooting



Wiper Board Overview – MAPWB-5.2
Throttle Circuit

- When the controller is powered, track power is applied to full power band
- Current is always flowing from the full power band to the first wiper band through the resistor chain
- This current flow is necessary to generate the voltage drops between each wiper band
- After the resistor chain, current will flow through the throttle sensitivity pot before exiting the wiper board through the grounded USB receptacle shell.
- The shell must be solidly connected to ground through a path consisting of -
  - the USB cable's internal shield to the power module ground
  - the power module ground to the controller's red brake wire
  - the controller's red brake wire to the track power supply's negative (-) output.

Figure 2. Wiper Board Current Flow – Partial Throttle



Connects wiper to power transistor drive circuit through USB cable

Wiper Board Troubleshooting

Problem – Controller stuck at full power

- If the current flow through the resistor chain is interrupted for any reason
  - Every point with a complete circuit path back to the full power band will be at full track power
  - Every point on the other side of the break will be at 0 (or near 0) volts
- Follow the steps shown in the order indicated, to measure voltage and troubleshoot this problem
- Likely causes of current flow interruption
  - Bad shield in USB cable breaking the ground path between the USB receptacle shell and power module ground
  - Disconnected RED brake wire at track breaking ground path between power module ground and track power supply's negative (-) line.
  - Track's brake circuit breaker is open.
  - Less likely causes are broken solder joints in wiper board resistor chain, broken throttle sensitivity pot, burned or broken traces in circuit path

Step 1 – Set Curve to Lin and Sensitivity to Min

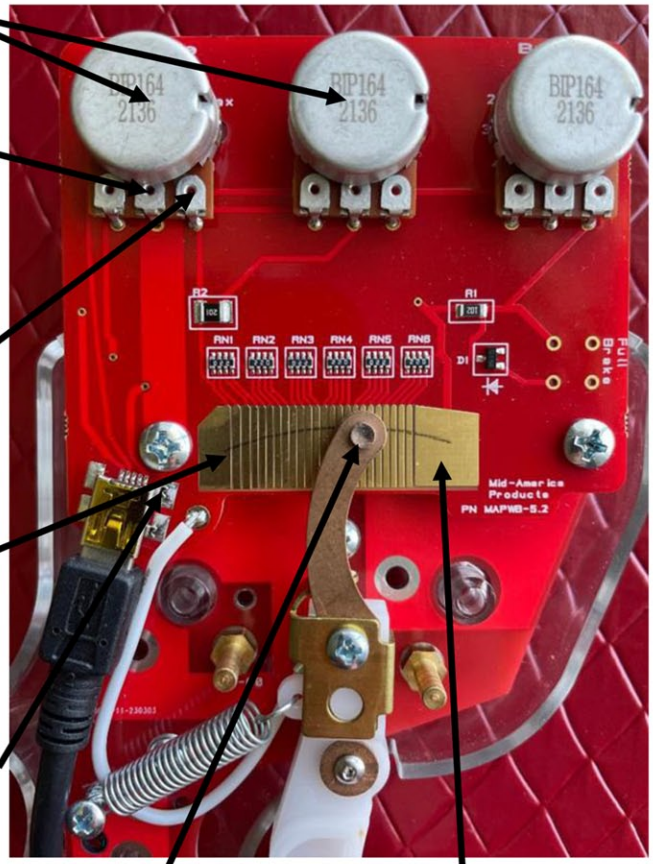
Step 6 – If full track power is present, pot is good. If 0V, pot is bad.

Step 5 – If full track power is present, connection to resistor chain is good. If 0 volts, break is between this point and first wiper band.

Step 4 – If full track power is present, the resistor chain is good. If 0 volts, a wiper resistor connection is bad.

Step 7 – If full track power is present, wiper board is ok. Problem is in ground path. If 0 volts, break is between this point and throttle pot.

Figure 3. Troubleshooting Steps – Controller Stuck at Full Power



Step 3 – Hold trigger in this position. If full track power is present on wiper, then current flow has been interrupted. If less than full track power, problem is in power module.

Step 2 – Measure full track power voltage.

Wiper Board Overview – MAPWB-5.2
Brake Circuit

- When the controller is powered, 5.1V (+/- a few tenths) is applied to the brake pot as shown.
- Current is always flowing from one end of the brake pot to the other, before exiting the wiper board through the grounded USB receptacle shell.
- This current flow is necessary to generate the voltage fed to the brake chip through the USB cable, setting the brake strength. (0V = Max brake, 5V = min brake)
- When voltage on the wiper drops below 1 volt, the brake chip is enabled and will read the brake pot voltage.
- When the trigger contacts the brake contact, it is shorted to ground through a path including a trace on the back side of the frame board, the wiper board mounting bolt / nut and USB receptacle shell. This pulls down the voltage on the wiper, and any band it is touching, to within a few millivolts of 0V, enabling the brake chip.
- The shell must be solidly connected to ground through a path consisting of -
  - the USB cable's internal shield to the power module ground
  - the power module ground to the controller's red brake wire
  - the controller's red brake wire to the track power supply's negative (-) output.

Figure 4. Brake Circuit Current Flow

Wiper Board Troubleshooting
Problem - No brakes or intermittent brakes

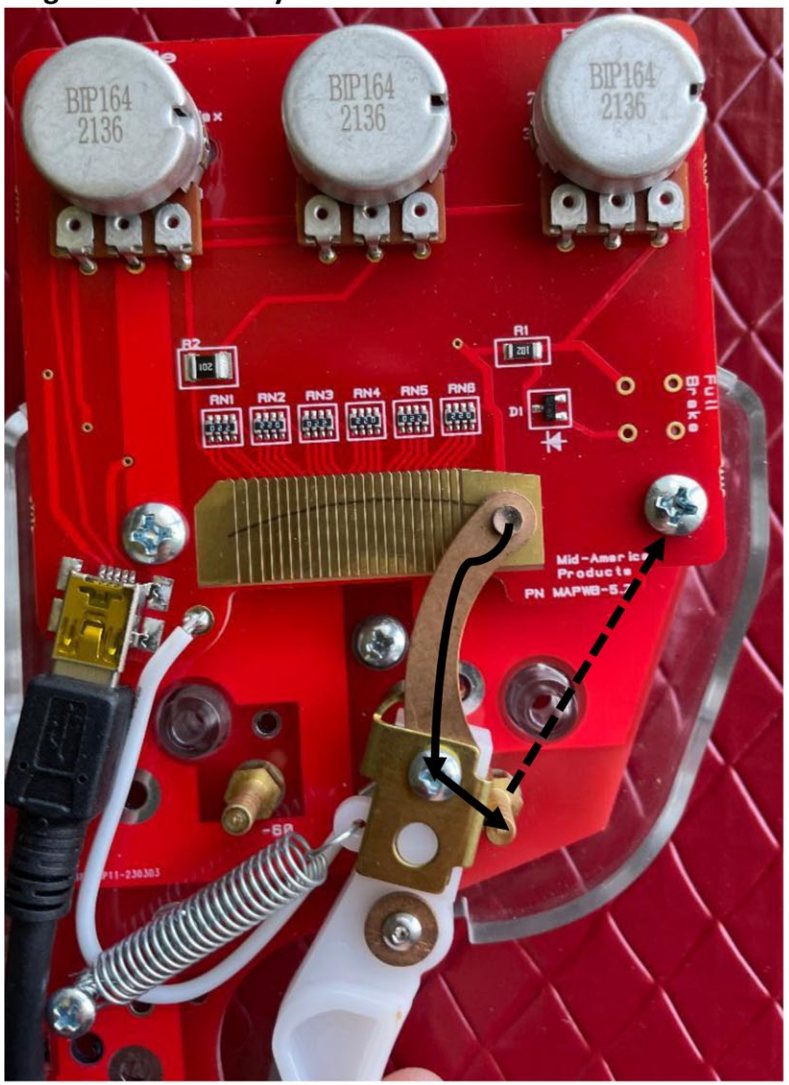
- A few quick checks will help you quickly narrow down the problem
  - First, set the Brake and Sensitivity pots to Max, and Curve Pot to Lin
  - If the throttle works properly and the brake LED lights up, the problem is likely in the power module, not the handle.
  - If the throttle works properly but the brake LED does not light up, the problem is likely in the handle. Either the brake pot circuit is not working or there is a break in the path to ground between the wiper arm and USB receptacle shell
  - Turn the Sensitivity pot down to Min. This will reduce the voltage on the first wiper band below 1 volt. If the brake LED turns on, there is definitely a break in the path to ground between the wiper and USB receptacle shell.
- Troubleshooting the wiper-to-USB receptacle shell ground path
  1. Turn the Sensitivity pot back to Max and measure the voltage on the wiper button. If within millivolts of 0V, the ground path is good and the brake chip should be enabled. If above 1 volt, there's a broken connection between the wiper and USB receptacle shell. Check the brake post – trigger contact and clean if required.
  2. If the wiper button voltage is still above 1V, measure the voltage on the brake contact. If above 1 volt, the broken connection is between the brake contact and the USB receptacle shell. If below 1 volt, the trigger still isn't making contact with the brake contact – adjust accordingly
  3. If the brake contact voltage is above 1V, measure the voltage on the wiper board mounting bolt head. If above 1V, the bolt head is not making good electrical contact with the wiper board trace. If below 1V, the bolt's retaining nut is not making good electrical contact with the trace on the back side of the frame board. Tighten / add washers accordingly.
- Troubleshooting the Brake pot
  1. Measure the input voltage to the brake pot as shown. It should be 5.1V (+/- a few tenths). If below 4.5 volts, the wiper board's Zener diode is likely shorted or the pot is bad.
  2. After verifying the pot's input voltage is good, measure the voltage on the brake pot's center tap. It should ramp from 0V to 5.1V as you turn the knob from Max to Min. If it does, the brake pot circuit is good. If stuck at 5.1V, a portion of the pot is broken / burned out, or the pot has a cold solder joint. If stuck at 0V, the pot may be broken / burned out or there is a problem in the power module.
- If both the wiper-to-USB receptacle shell ground path and brake pot are good and the brake LED still does not light
  - Look for broken solder joints at the brake pot center tap and USB receptacle
  - Wiggle the USB cable / receptacle connection in the handle. Take them apart and visually inspect the contacts. If anything looks burned/discolored – change the cable. Push down slightly on the receptacle's retaining tab before reinserting the cable for more positive retention.
  - If the problem was a loose cable connection, be sure the cable's strain relief at the handle bottom is set properly. Don't forget to add the strain at the handle bottom when replacing the USB cable.
  - Check the USB cable / receptable connection at the power module.
  - Try a different USB cable
- If the brake LED still does light, move on to troubleshooting the power module

Figure 5. Troubleshooting Steps – Brake Circuit

Wiper Board Overview – MAPWB-5.2
Blast Relay Circuit

- When the controller is powered, track power is applied to full power band
- When the trigger contacts the blast relay contact, it completes the circuit between the full power band and the relay contact, energizing the blast relay.
- Current flows from the full power band to the blast relay contact through the wiper arm and trigger. It continues through a trace on the back side of the frame board, up the wiper board mounting bolt / nut, and exits the wiper board through the USB cable. The trace from the mounting bolt head to the USB cable is on the underside of the wiper board.

Figure 6. Blast Relay Circuit



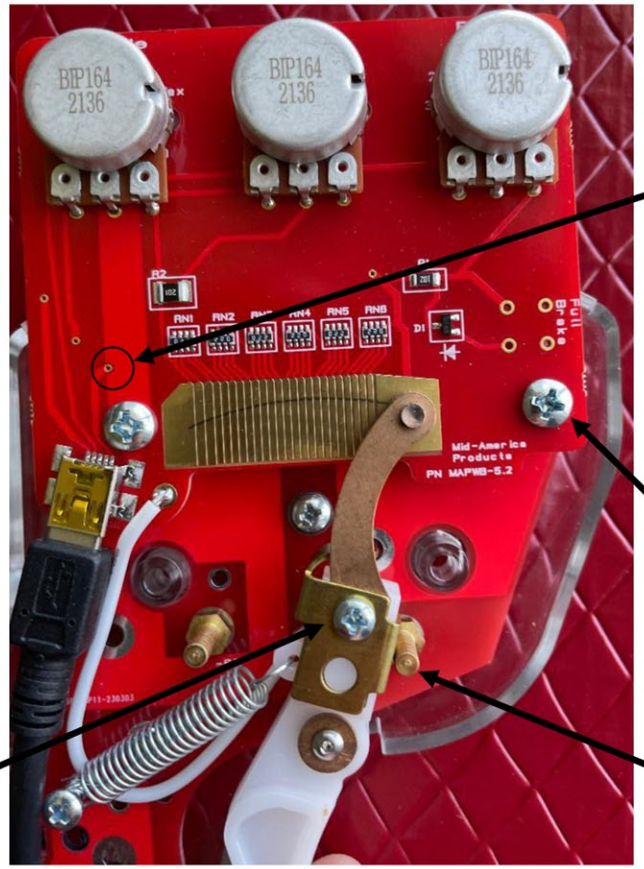
Wiper Board Troubleshooting

Problem – Blast relay not working at all or intermittently.

All voltage checks are made with trigger in the position shown, making contact with the blast relay contact.

- The wiper button must make contact with the full power band to power the blast relay. Make sure the wiper button isn't lifting, especially if the customer has "gorilla grip".
- All blast relays have a specified pick-up voltage for the relay coil, typically in the 7 to 9 volt range. If less voltage is applied to the coil, it may (or may not) close the relay contacts. Be sure the track power isn't turned down too low.
- Follow the steps shown in the order indicated, to measure voltage and troubleshoot this problem
- If full track power is present at the via in step 4 -
  - Look for broken solder joints at the USB receptacle
  - Wiggle the USB cable / receptacle connection in the handle. Take them apart and visually inspect the contacts. If anything looks burned/discolored – change the cable. Push down slightly on the receptacle's retaining tab before reinserting the cable for more positive retention.
  - If the problem was a loose cable connection, be sure the cable's strain relief at the handle bottom is set properly. Don't forget to add the strain at the handle bottom when replacing the USB cable.
  - Check the USB cable / receptable connection at the power module
  - Try a different USB cable
- If the blast relay still doesn't work, move on to troubleshooting the power module

Figure 6. Blast Relay Circuit



Step 4 – If full track power is present at this via, the bolt's head is making good electrical contact with the wiper board. If 0V, tighten / add washers accordingly

Step 3 – If full track power is present on bolt head, the bolt's nut is making good electrical contact with the frame board. If 0V, tighten / add washers accordingly.

Step 2 – If full track power is present on blast relay contact, trigger is good. If 0V, clean contact and trigger

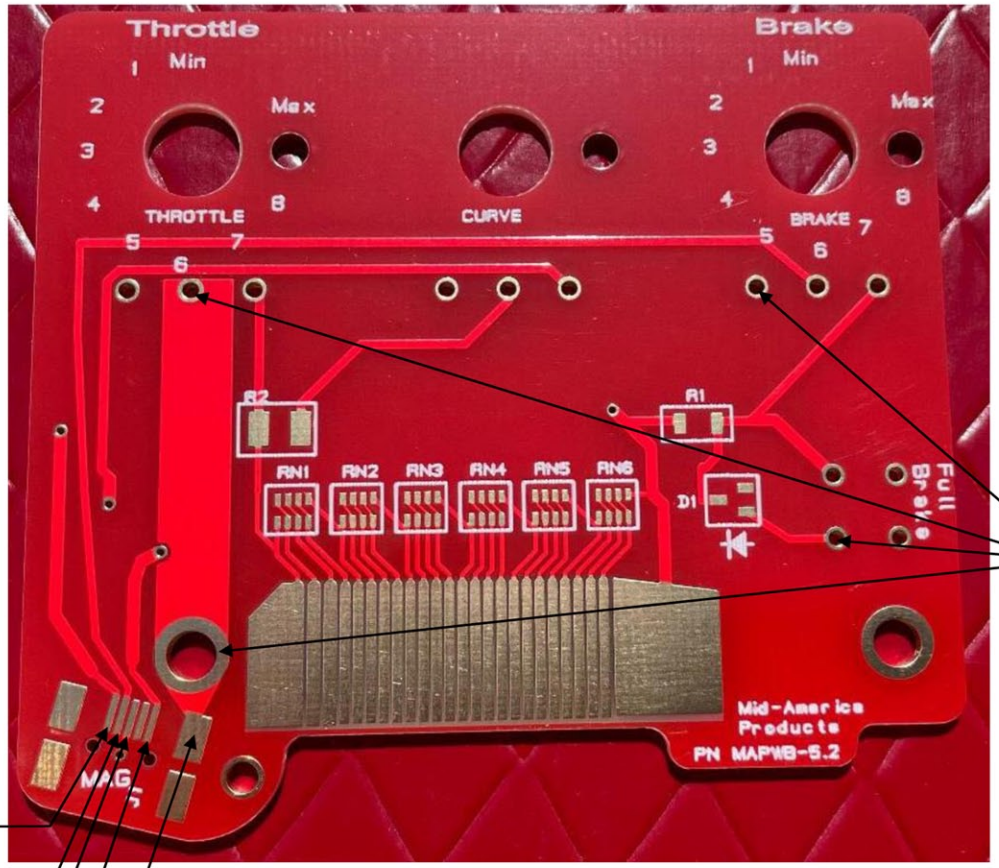
Step 1 – If full track power is present on trigger, wiper button is good. If 0 volts, wiper button is lifting

Wiper Board Overview MAPWB-5.2
Response Curve Circuit

- The response curve pot is connected to the wiper button as shown in Figure 7.
- When the response curve pot is set to Lin, its resistance is so high that the wiper arm does not pull any current from the resistor chain.
- When the response curve pot is turned toward Crv, its resistance is lowered enough that current begins to flow from the resistor chain through the wiper arm. This affects the voltage drops between each wiper band, curving the throttle response.
- The voltage on the first one or two wiper bands is not really affected by the curve circuit. The wiper chain resistor values are so low compared to the resistance of the curve pot and R2, voltage on the first power band is unaffected by the wiper arm current.
- The voltage on the full power band is unaffected by this circuit. It will always remain at full track voltage.
- R2 serves two purposes
    1. It raises the resistance of the circuit to make the response curve pot usable throughout more of its resistance range.
    2. It limits current through the curve circuit to safe levels when the response curve knob is turned all the way to Crv, the throttle sensitivity is set to Min and the wiper is on the upper wiper bands. In this scenario, both pots have zero ohms resistance - R2 is the only resistance left to prevent a short circuit to ground. That is why R2 is a higher wattage resistor than others on the board. Note – the controller response would be way too soft to be usable with these settings, so I don't expect this scenario to occur during normal operation.

Figure 7. Wiper Board Current Flow – Curved Response

USB Receptacle Connections – MABWB-5.2



Track Power Input

Brake Pot Output

Wiper Output

Blast Relay Output

Ground pad

These points connect to the ground pad at the USB receptacle.

The USB receptacle shell is soldered to the ground pad.

The ground pad is connected to the power supply's negative (-) through the "ground path" – the USB cable, power module ground and red brake wire.

Revision History

6/3/23 - Initial Release