Driver Station ESD Sensitivity Rework Instructions

The 2009 FRC Driver Station has been found to be sensitive to electrostatic discharge (ESD). To ensure continued reliable operation, teams should perform the simple rework that follows.

The purpose of this rework is to electrically connect the Driver Station's internal ground with its metal housing. This will allow the housing to more effectively shield the electronics and does not void the warranty, as it is not necessary to open the case
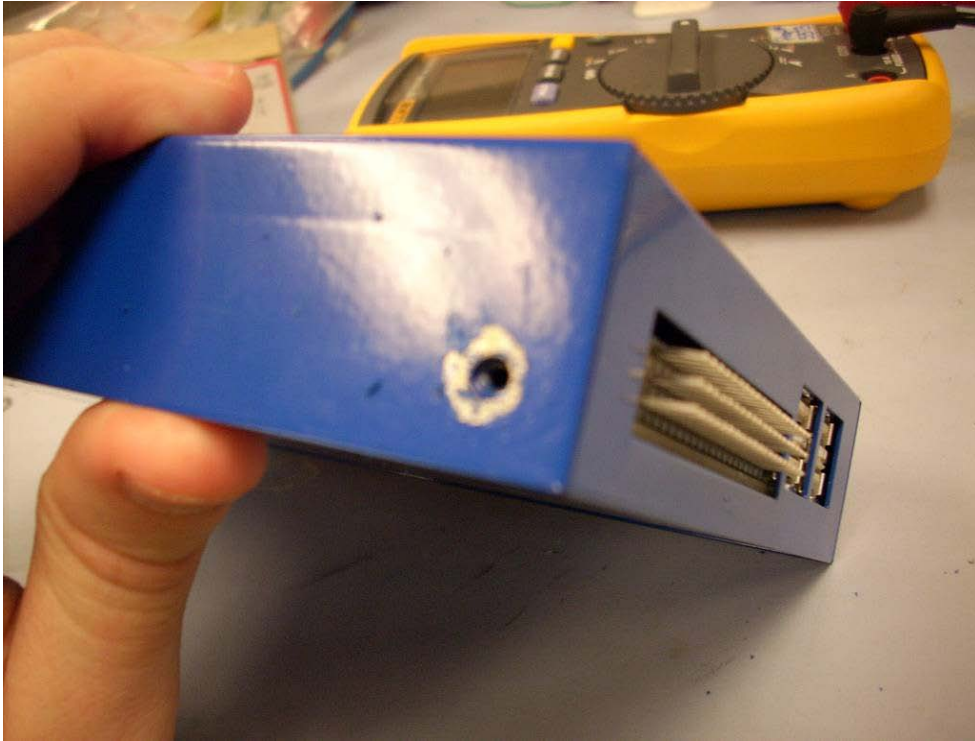
Required Tools and Materials:
- Safety Glasses
- Screwdriver, Phillips
- Wire Strippers
- Multi-meter or Ohm Meter
- Crimper
- File or other scraping instrument
- 3 Conductor PWM Cable or similar (such as a Y PWM Cable).
- Ring Crimp (#6)
- Star Washer (Optional)

1: Prepare the Casing

The casing has a thick insulating layer of paint that will prevent good electrical contact.


Locate the mounting screw adjacent to the I/O port. Insert and remove this screw several times to push the paint out of the threads.

Remove the paint surrounding the screw hole using a file or other scraping tool. Be sure to wear your safety glasses. Using a star washer later will allow for some slop in this step, and we will later verify contact.

2: Prepare the Cable
Create a short cable to connect at least one ground pin of the IO port pins to the case; multiple ground pins would be better. Shown here is a RC Extension (or PWM) cable being used for this connection. These instructions assume the use of a 3-conductor cable.
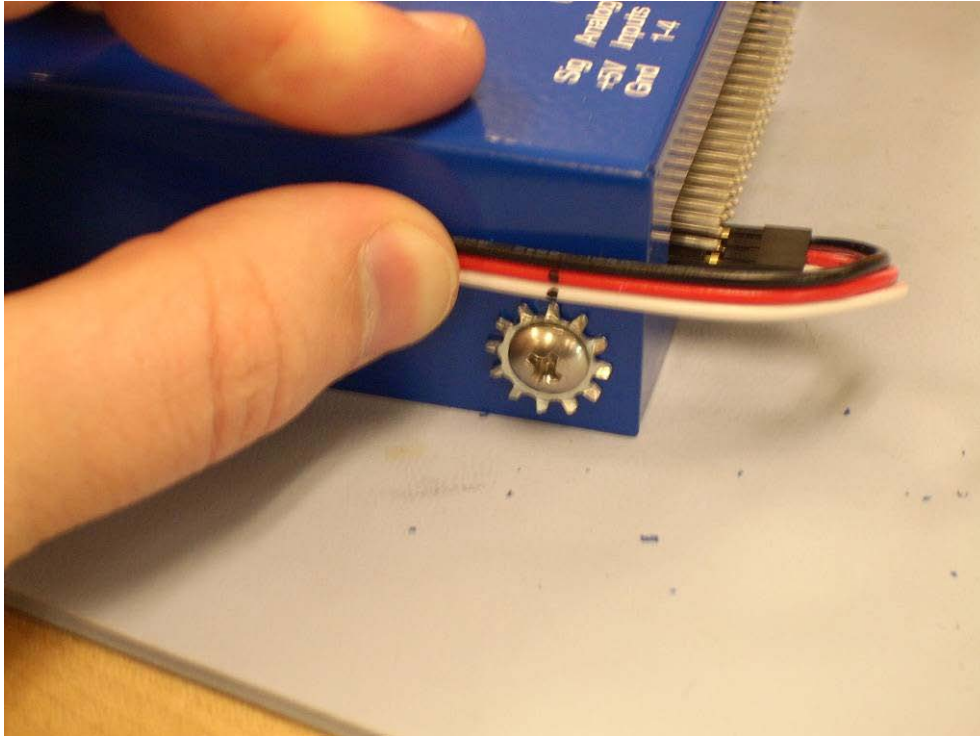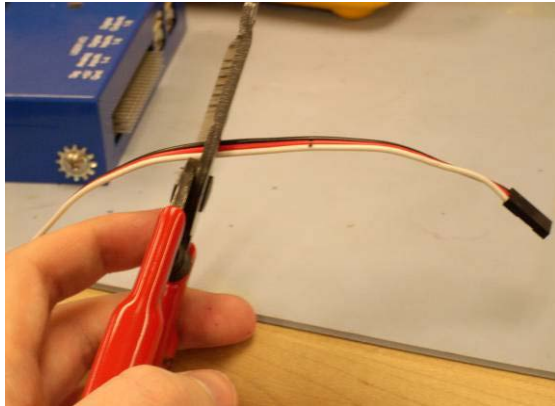

Insert the 3 Conductor cable into the 3 closest grounding pins (Analog Inputs 1-3).

Leaving room for some slack, mark the cable at the screw center.

Cut the cable half an inch to an inch beyond the mark, and strip to the mark.

Crimp a ring terminal to the end of the cable. Use all 3 of the conductors of the cable.
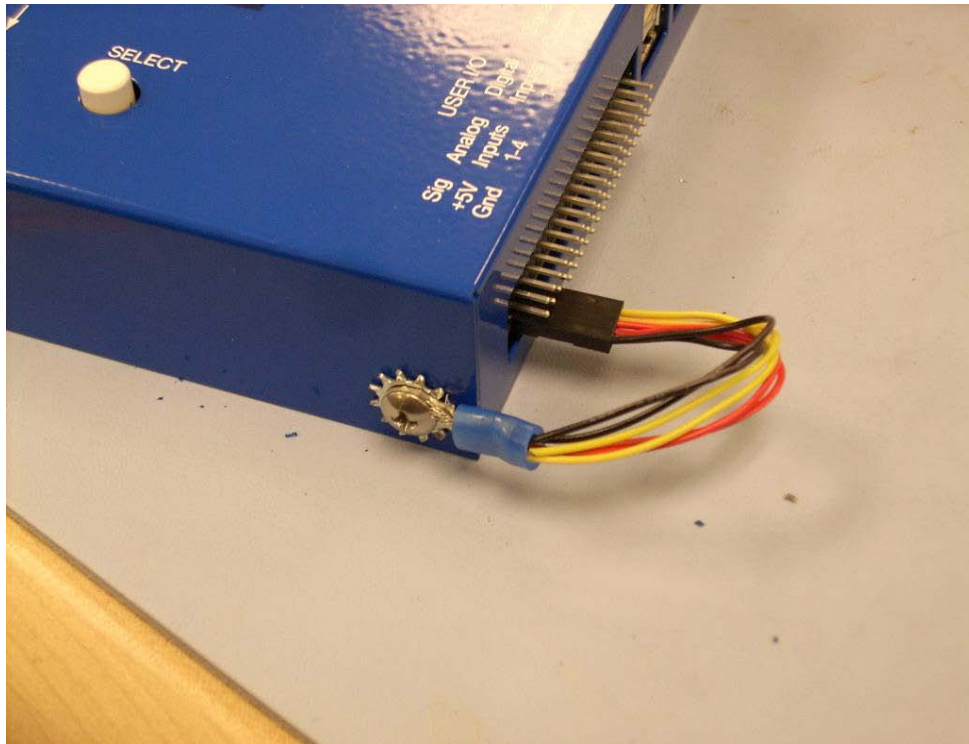
Give a smart tug to ensure that your crimp is solid.

Note: the picture on the right shows a Y cable; this is another acceptable RC Extension cable option.

3: Attach and Verify

Connect the cable and make sure it is doing its job. This picture shows a Y cable being used.


Reinsert the screw such that it is "Case -> Star Washer (optional) -> Crimp -> Screw". Screw tightly to ensure good contact, but do not over torque.

To Verify set your Multi-meter to Continuity Tester mode. Check for continuity between:

1. One of the I/O port's ground pins and an electrically conductive section of the top of the case, this checks the upper case connection.
2. One of the I/O port's ground pins and an electrically conductive section of the bottom of the case, this checks the lower case connection.

The easiest point to grab on the top of the case is the hole for the reset switch. On the bottom, select one of the mounting standoffs. If your multi-meter probes are too large, you may need to scrape some of the case paint away to ensure a good test connection. Another option for testing would be on the other screws that secure the case.
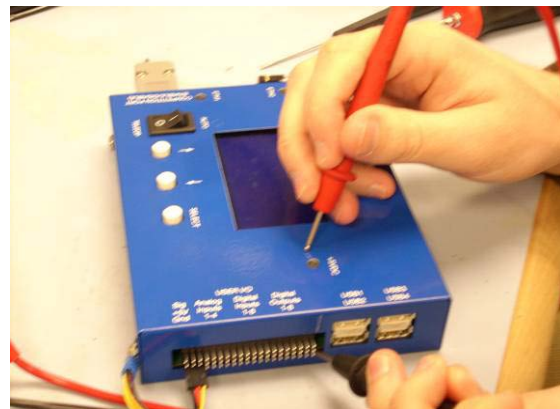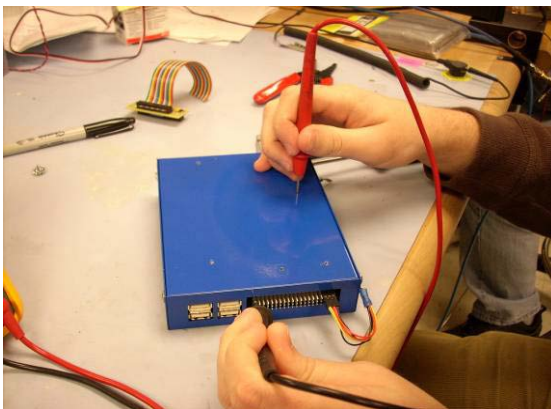
FAQ

Q: Do I have to use a PWM Cable or RC Extension Cable?
A: No. These instructions assume that most teams have a PWM cable on hand. Just be sure to minimize the impedance between the pins and the case. We have used 0.1" IDC successfully.

Q: Do I have to use 3 conductors?
A: Theoretically, a single ground connection between the printed circuit board and the case should be all that is needed to eliminate electrostatic discharge. Our testing to investigate this problem indicated that using additional connections provides additional security. It is highly recommended to use 3 conductors. We experimented with using a single wire and found that it did not provide the same level of protection as three. Additionally, we found that using the 6 conductors of a Y-cable provided a very slight improvement over a standard PWM cable. We hypothesize that this is because of the skin effect, which implies that using a single heavy gauge wire would not be as effective.

Q: How do I use the analog inputs?
A: You can use the ground pins from the digital input / output. They are all common on the PCB, so your only impact will be ease of wiring. If you find a cleaner method, please share!

Q: I've done the rework, but my Joysticks still lock up after an ESD event.
A: This rework protects the central processor of the Driver Station, but the USB hub chips and/or the Joysticks are still sensitive. An electrostatic discharge has the same effect as unplugging and re-plugging the joysticks.

Q: The _____ component on the Driver Station seems damaged! What do I do?
A: Please report the issue so that we may continue to improve. Please report the DS to *FIRST* via ~~the~~ frcparts@usfirst.org and check for similar postings on the *FIRST* forums. If the Driver Station is damaged, and not covered under warranty, check the "Where to Get More?" link in Section 10 of the 2009 *FIRST* Robotics Competition Manual page (http://www.usfirst.org/community/frc/content.aspx?id=452) for instructions on purchasing a replacement.