

Auto Start/Stop Disable and Drive Mode Default Project

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Overview

This was tested on an Arduino Nano Every, in the following vehicle:

2022 Maverick EcoBoost Lariat Luxury w/4K Tow (no FX4, no Moonroof)

Everything is handled by the Arduino and circuits; nothing is stored in the vehicle, and nothing is permanently changed in the vehicle's computer. You only need to wire the circuits for the feature(s) you want to use. However, you will need to modify the Arduino code slightly; there are #defines you set based on what you have implemented. These are fully described in the Arduino code.

Background on what was learned and a high-level description of how this works:

- When the physical button is pressed, in the center console, the button's wire is shorted to ground. The Arduino code and circuit mimics the user pressing the physical button by temporarily shorting the button's wire to ground.
- Testing showed there are two power states for the accessory fuses in the passenger interior fuse box. Fuse #3 gets power when the vehicle is just remote started, and you have not gotten into the vehicle and pressed the ignition Start button or used the ignition key. Fuse #6 doesn't get power until the vehicle is fully started, which is after you have gotten into the vehicle and pressed the ignition Start button or used the key.
- For the fuse box power, I used an automotive connector so the Arduino can be disconnected easily. I put the connection right above the main connector for the center console. Not only so you can just disconnect the Arduino, when taking it in for service, if you want, it would be a familiar connector for the service technician if they needed to remove the center console.
- Testing also showed that Auto Start/Stop can be changed if the vehicle is just remote started. However, the actual Auto Start/Stop light does not turn On if the vehicle is just in the remote started state. The Auto Start/Stop light will turn On when the vehicle is fully started. Drive Modes can only be changed after the instrument cluster has booted up, which is ~5 seconds after the vehicle is fully started or in accessory mode.
- Since everything can be set after the vehicle is fully started, it would be best if Arduino did not get power until the vehicle was fully started. However, the fuse taps do not allow this to be easily done, so the Arduino code and circuits can handle getting power when vehicle is just remote started as long as you implemented the following circuits:
 1. Auto Start/Stop light detection
 2. Auto Start/Stop button pressing

The code will press the Auto Start/Stop button when the vehicle is remote started, then wait for the Auto Start/Stop light to turn On (i.e. vehicle is fully started). Once that happens, the code wait for 5 seconds and then configures Drive Modes. If the desire is to not have Auto Start/Stop disabled, that button is pressed again.

- Another issue was when the Arduino is connected via USB to a computer. When USB is connected, the Vin pin gets ~5V. This would feed back to the vehicle's fuse. In that case, the vehicle would not turn off until the USB is disconnected. This is overcome with the 'Allow USB to be connected' circuit. You are not required to wire this circuit; you just should not use the USB when the Arduino board is connected to your vehicle. In my testing, having USB and vehicle power connected at the same time did not cause any problems, but I do NOT recommend it at all.
- To test your circuits before you try to put it in the vehicle, you will need to wire up buttons in a specific way, so it mimics how the vehicle is wired. If you do not do this, then the Arduino will get false presses because the pins are not tied to 12v or Ground (i.e. are floating). This means the switch pins must be pulled high (tied to 12v via a resistor), when the pin is not being pressed. And when pressed, the pin is tied to Ground. We cannot add this to the Arduino board, because it interferes with the vehicle. It is hard to mimic the Auto Start/Stop light manually. This is because you need a have a specific periodic pulse that is high for 400 microseconds and then low for 4.51 milliseconds (4510 microseconds). One option, unless you have a PWN signal generator, is to use a second Arduino; the code for this is given in the main comment block of the Arduino code.

Determining connectors

This is how I figured out the connectors needed.

The brand is on the side: Molex. The connector series number is on the side, but that is not the full part number. To get the rest of the part number you need to pick: 1) number of pins, 2) bridged vs non-bridged, and 3) the polarization options. This is where the data sheets come into play (I'll include links to them below). Looking at drawings, these are non-bridged. These also are polarization option A, which can be seen by the way it looks and because it is black; the polarization options are in different color.

For the Auto Start/Stop & Drive Mode switches, the plug on the wiring harness has 34728. I could not find that number, but found 34729, which worked. Being 12 pin and option A, the full part number is 34729-0120. Here are links for it:

Series: https://www.molex.com/molex/products/part-detail/crimp_housings/0347290120

Data sheet: https://www.molex.com/pdm_docs/sd/347290120_sd.pdf

If you look for "Mates with Part", that is how you determine the male connector the plug goes into. Since I am making a harness, I went with 'Vertical' header. This means the connections on the back, that you will solder the wires to, stick straight out. You do the "Right Angle" one if you want, or when mounting to a board, but definitely do not want "Surface Mount" ones. We can ignore "Tray" vs "Tube" packaging, that's just how they get delivered in bulk; which we are not doing. That means the mating part number we want is 34690-0120.

The next thing is the pins for the plug. The female plugs do not come with pins, while the male connector/headers do. You look for "Use with Part", to get the female terminal's (i.e. pin's) series number. In this case 34803. For the rest of the pin part number, you have to pick from: 1) wire gauge (i.e. AWG), 2) Gold vs Tin, in some cases. You will see 'Wind' and 'Payoff', which have to do with the roll they come on, but we ignore that because we are just getting individual pins (aka Loose Piece). The 'Grip' relates to the wire gauge. I went with 22 awg because seems the closest to the factory wires. Other than the vehicle 12v power, Tin is fine. Probably fine for the 12v, but since Gold is rated for 5 amps and I am using a 5 amp fuse tap, I went with Gold for the 12v pin. This means the pin part number is 34803-3211.

Electronics

For the board to hold everything, I used a simple perf board. You could look for a solderable breadboard; have seen them on Amazon. To make sure connections do not get loose from vibrations and do not get accidentally shorted, I hot glue all if. I didn't do the topside of the Arduino.

For the resistors, I went overboard and got high wattage ones. Mainly to hold up to the vehicle's interior heat better.

For the wires, I went with TXL High Temp automotive wire. Again, something that will hold up to the interior heat.

For wrapping the wires, I went with cloth tape. Normal electrical tape will get gooey in the interior heat.

Tips for attaching wires to the pins:

- I found the insulation on the wires to be a little big, so take care when trying to insert the terminal/pins fully into the female connector. What I found helped was to have the insulation butt up to the first set of grips on the terminal/pins; as long as you solder them.
- I soldered my wire to the terminal/pins, to help with inserting and to guarantee a good connection. When applying the solder, have the terminal/pin pointing straight up so solder will run down the wire and not into the area the male pins go into (you can guess how I figured that out).
- The key to crimping the terminal/pins is to be sure the width & height of the crimp is no bigger than the end where the male pins will go into, otherwise it won't insert all the way. The width seemed to be trickier one. There are specific tools for this, but are expensive,
- For the male connectors, I soldered directly to the pins that come out the back. Just take your time as they are close together. Then I hot glued to fill the gaps to help keep the pins from bending into each other.

NOTE: there are specific tools for crimping the female terminal/pins, but I felt they were too expensive

Where to purchase

You can buy the connectors most this online from places like:

Mouser Electronics: <https://www.mouser.com>

Digi-Key Electronics: <https://www.digikey.com>

I went with Mouser.

Watch the pricing on Mouser, they give price breaks at certain quantity levels. For example, you might need just 8 of something that has a price break if you buy 10. It might be cheaper to get 10 and have spares.

For pins, make sure you are getting "Loose Piece". The rolls come with a ton of pins, you just need a few.

The 'Stock' quantity is what matters, that is what they have currently. The 'Factory Lead-Time' is how if 'Stock' is zero.

I mainly got spare pins because they are cheap and easy to mess up. Besides the Arduino, the rest of the electronics used can handle accidental shorts, so they are robust. The connectors are robust, if you don't go crazy with the soldering iron and melt the plastic. The Arduino is something to consider getting a spare in case you short something; and it can be used for some testing.

Parts list

Items from mouser

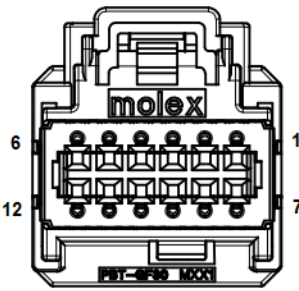
	Part number	Description	Qty	Price \$
Patch wire for Auto S/S and Drive Mode switch	34729-0120	Female connector that plugs into vehicle's switches	1	1.20
	34690-0120	Male connector for vehicle's wire to plug into	1	2.17
	34803-3211	Pins (22awg Std tin 1.5A)	8	0.11
Arduino board	34791-0080	Female connector for part of wire harness that will connect to Arduino board	2	1.03
	34793-0080	Male connector to mount to the Arduino board	1	1.99
	560023-0448	Pins (22awg Tin 4A)	4	0.11
	560023-0548	Pins (22awg Gold 5A)	2	0.17
Power from fuse box	216281-1023	600mm con & wire 14a – goes to fuse box	1	6.19
	216283-1023	600mm con & wire 14a – goes to Arduino board	1	6.05
Board	7100-45	Perf board	1	4.50
Arduino	ABX00033	Nano Every with headers	1	16.88
Headers by Adafruit	5585	So Arduino is removable (not required)	1	1.13
Electronics	IRLZ44NPBF	N-Channel mosfet	4	1.66
	IRF5305PBF	P-Channel mosfet	2	1.80
	FMP300FTF73-10K	Resistors - 10K 3W	8	0.41
	SBM1045VSS_AY_00001	Diode - 45V Schottky 10A	1	0.58
Momentary switches	COM-09190 or equivalent	Momentary pushbuttons. Can be anything, just something for the test circuit that simulates the buttons in the vehicle	2	0.50

Items from other places

	Qty	Price \$
Wire – 22 AWG TXL high temp https://www.ebay.com/itm/294048245340	1	15.94
Cloth tape https://www.amazon.com/gp/product/B01HT11J9I	1	7.29
Fuse Tap - Littelfuse FHM20200ZP Micro2 Add-A-Circuit (Advance Auto, Amazon, etc.)	1	7.29

Wiring Harness

Auto Start/Stop and Drive Mode Connectors



Female Plug

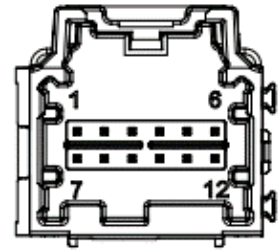
(looking at end that goes into the buttons/male connector)

Pin - Description

- 1 - Drive Mode button
- 3 - Auto Hold button
- 4 - Auto Start/Stop Button
- 6 - Nighttime lights
- 7 - Auto Hold light
- 10 - Traction Control button
- 11 - Auto Start/Stop light
- 12 - Ground

wire color I used

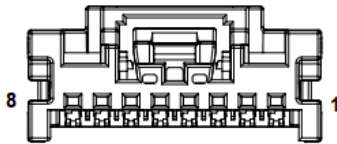
- orange w/ brown
- white w/yellow
- red w/yellow
- purple w/red
- green w/brown
- yellow w/blue
- blue w/brown
- black w/red



Male Connector

(looking at end that the female plug goes into)

Arduino Board Connector



Female Plug

(looking at end that goes into the Arduino board male connector)

Pin - Description

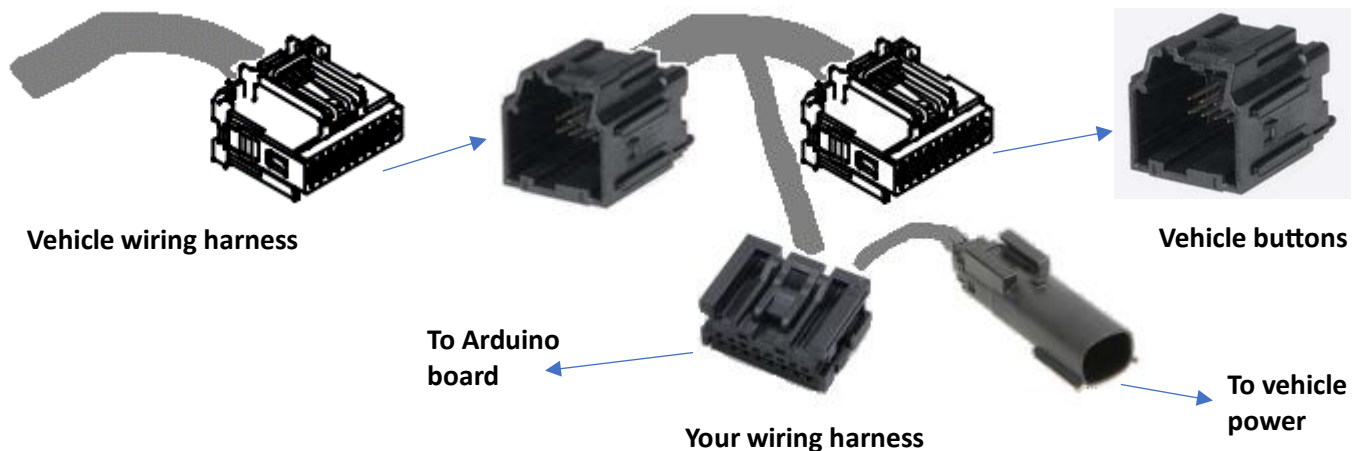
- 1 - Vehicle Ground
- 2 - Vehicle 12v
- 5 - Drive Mode button
- 6 - Auto Start/Stop button
- 7 - Auto Start/Stop light
- 8 - Ground

wire color I used

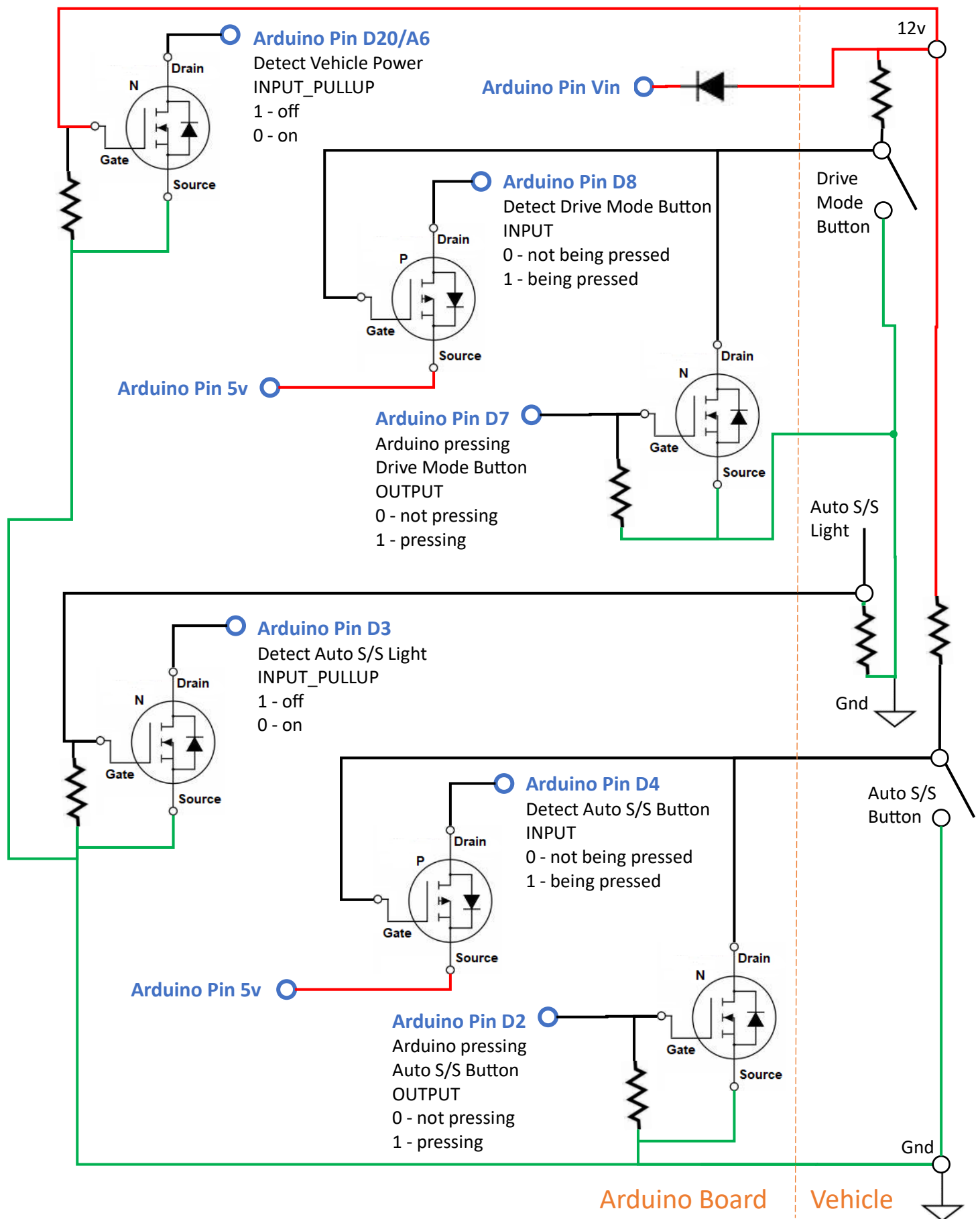
- black from 216283-1023
- black from 216283-1023
- orange w/brown
- red w/yellow
- blue w/brown
- black w/red

Harness Connections

The new wiring harness, will have female plug on end and the male connector in the other. The female plug from the vehicle's wiring harness will plug into the male connector of your new wiring harness. The female plug from your new wiring harness will plug into the vehicle's buttons.



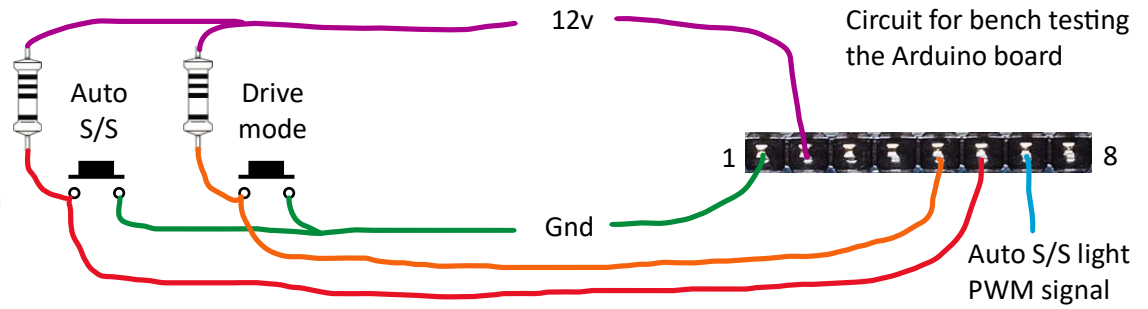
Schematic



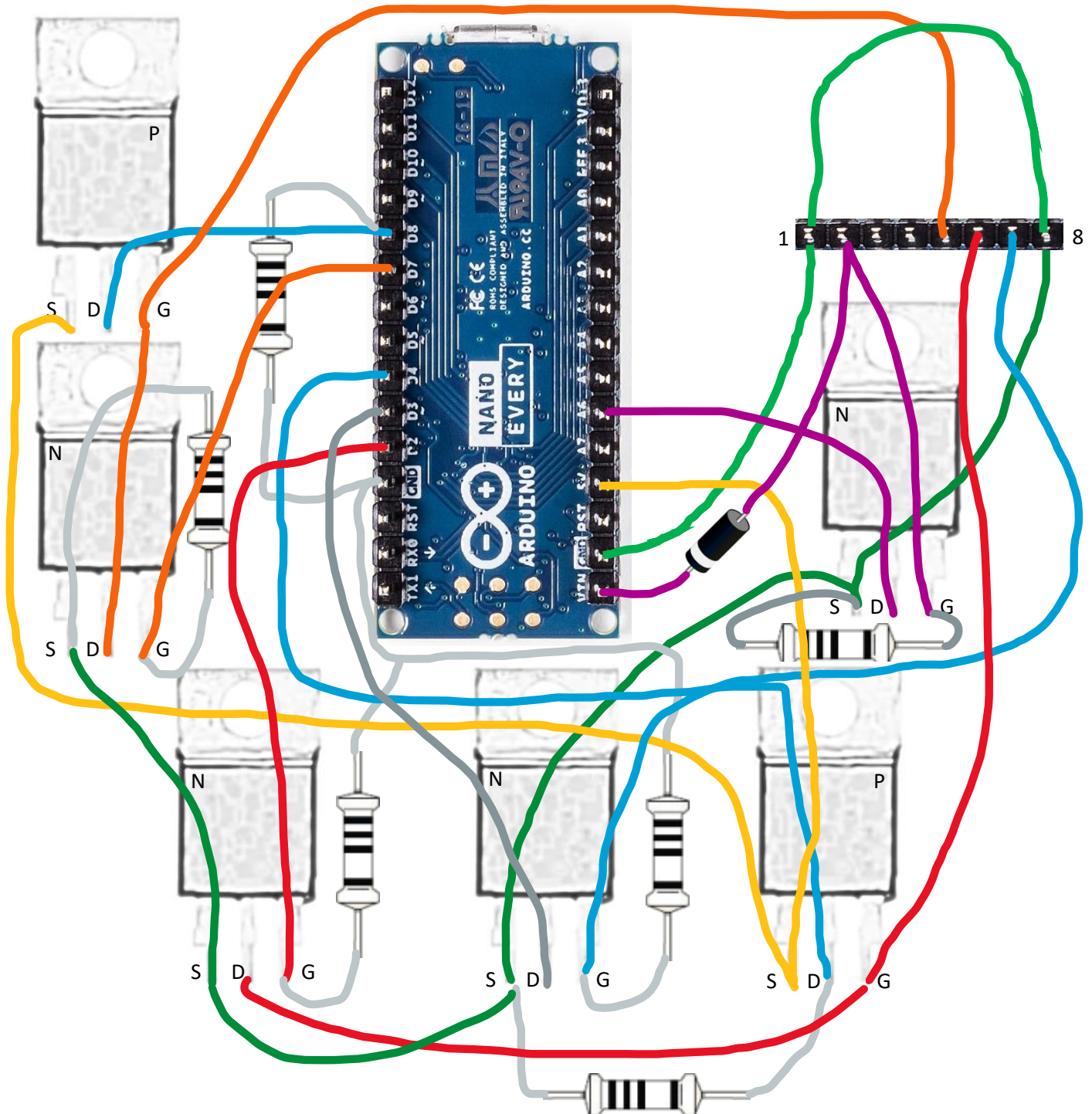
Parts Layout

Entire Circuit

NOTE: Arduino's USB can be connected when board is in the vehicle



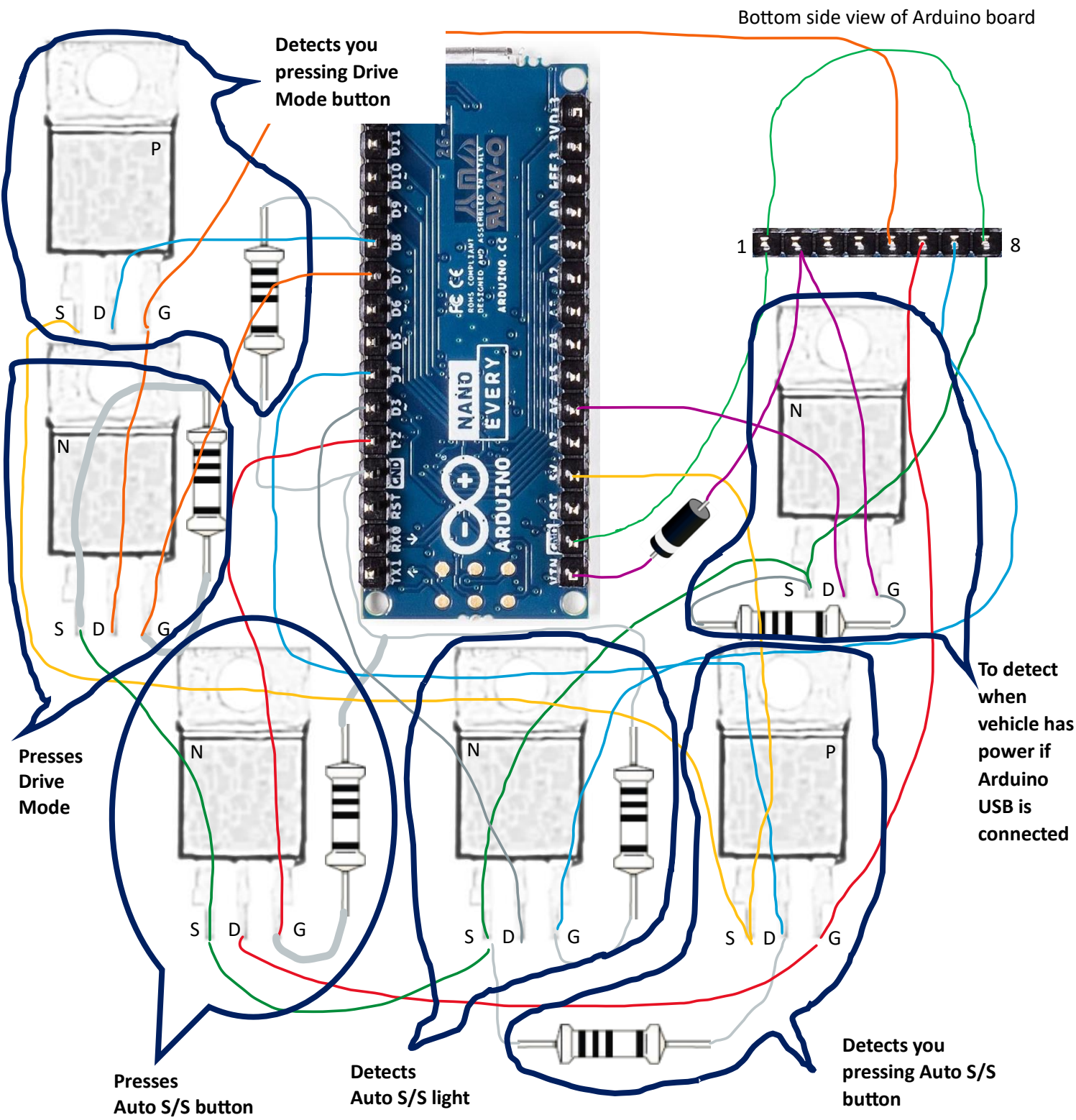
Bottom side view of Arduino board



The Different Circuits Labeled

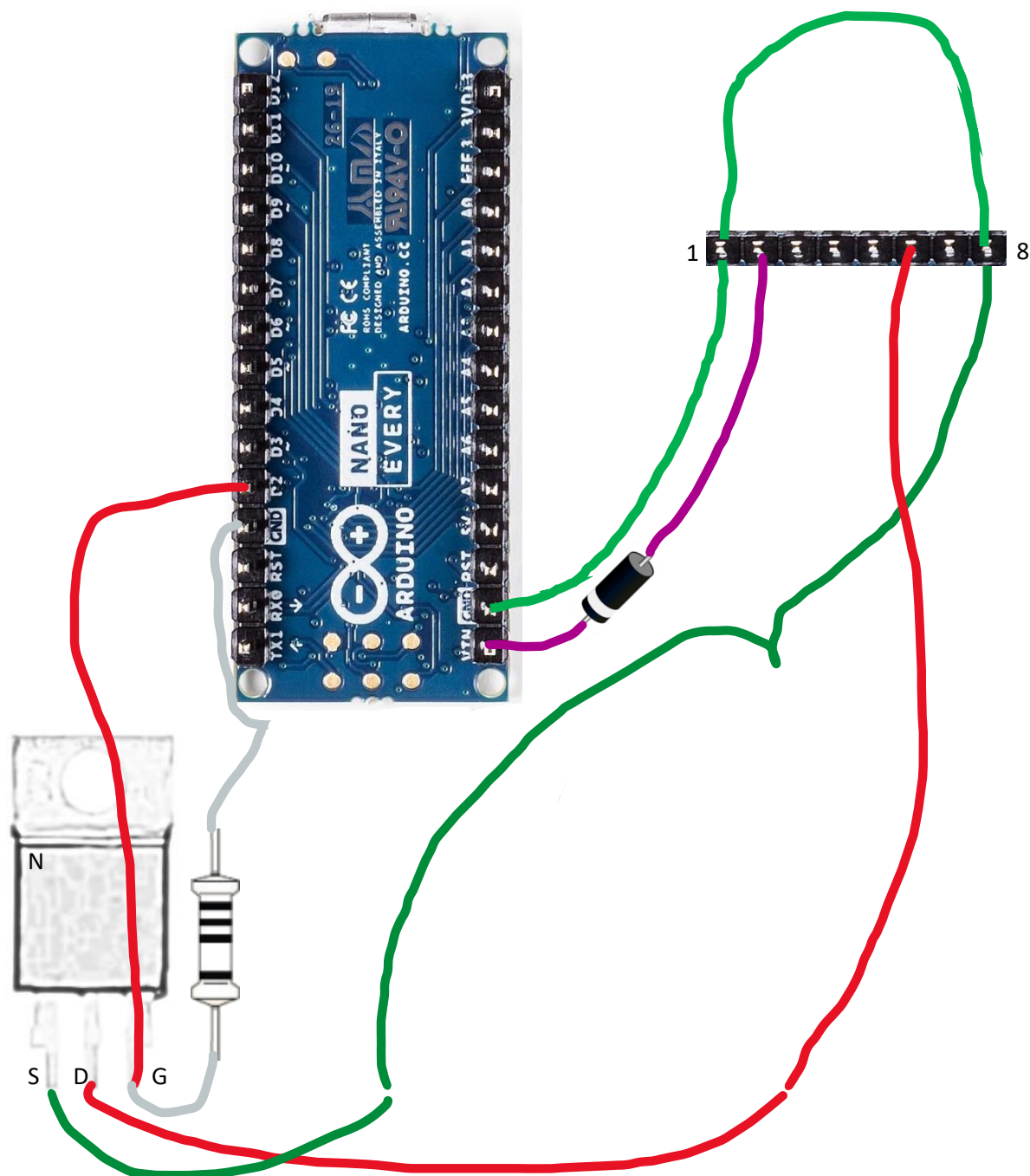
NOTE: Indicates which Mosfet and Resistor are for each of the circuits.

NOTE: The diode is always required.



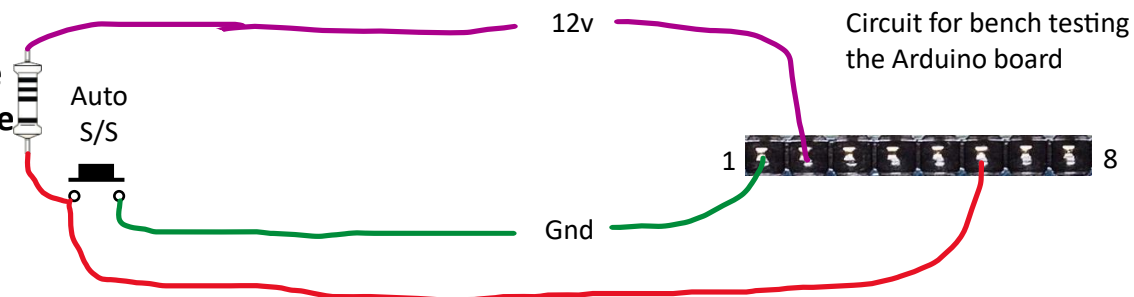
NOTE: Arudino's USB **CAN NOT** be connected when board is in the vehicle

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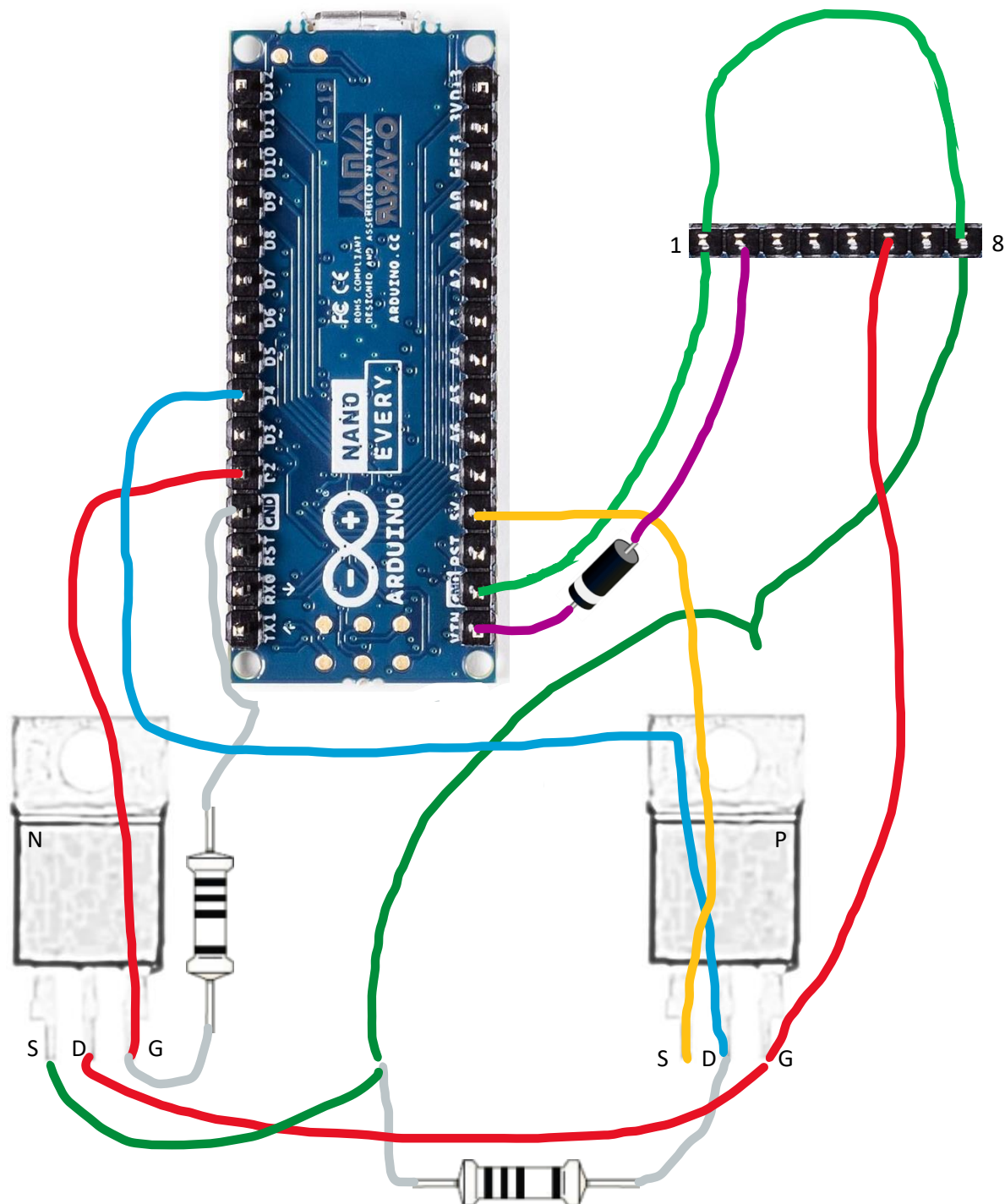


NOTE: Arudino's USB **CAN NOT** be connected when board is in the vehicle

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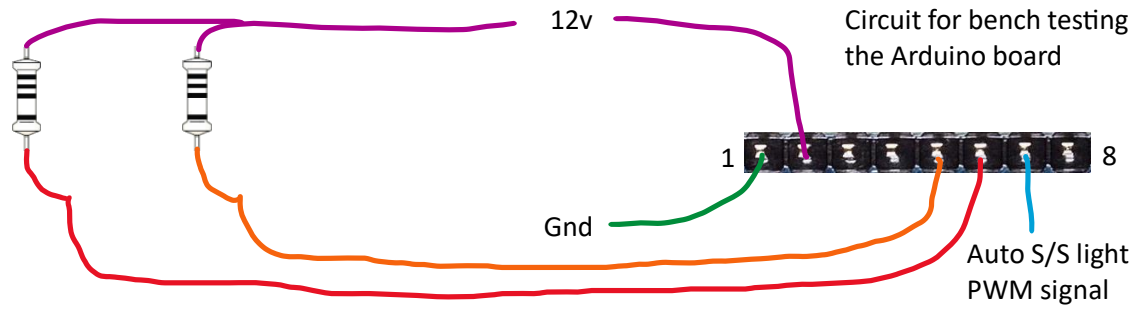


Bottom side view of Arduino board

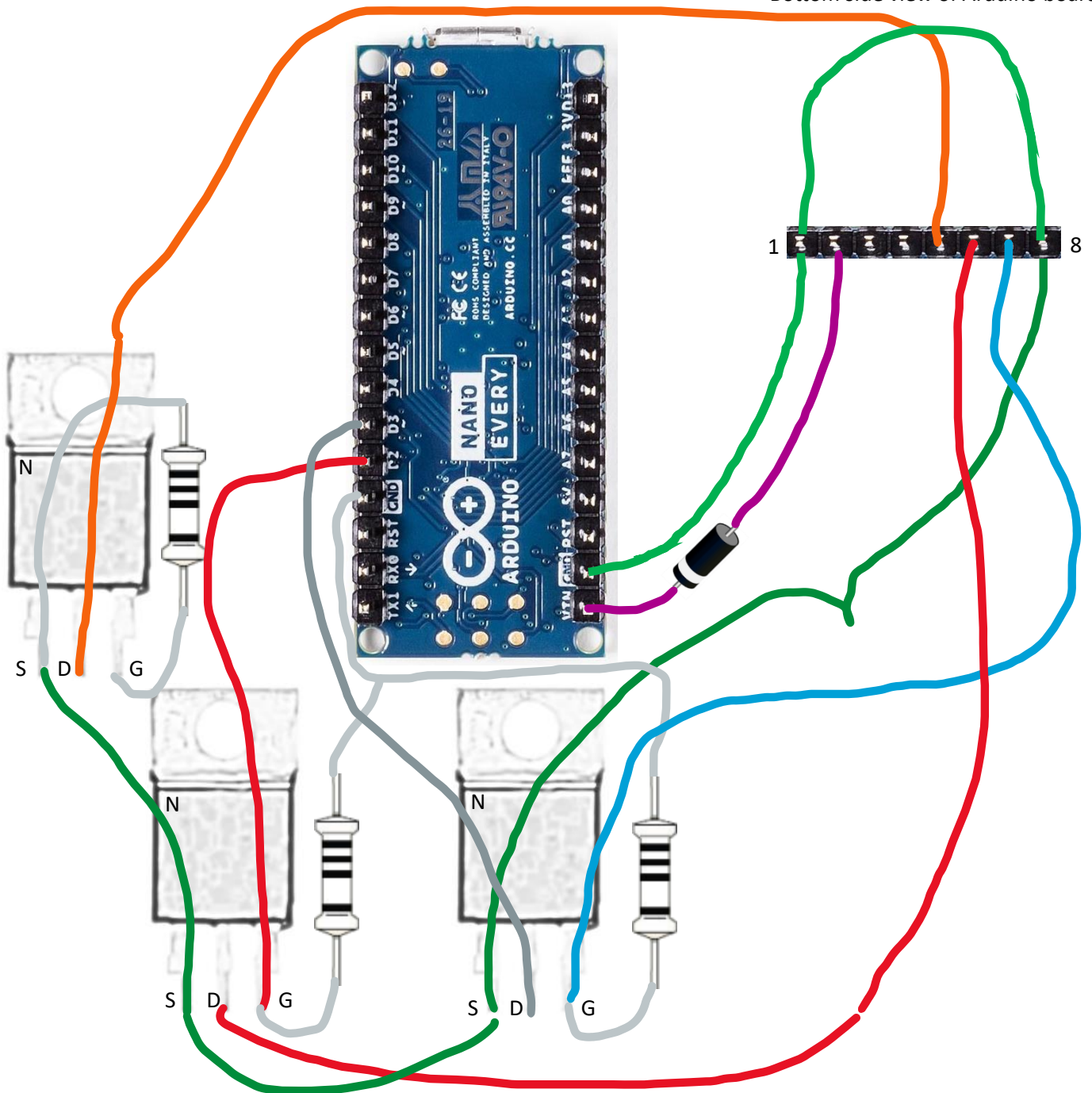


Just Drive Mode Default - Remote Start Support

NOTE: Arduino's USB
CAN NOT be
connected when
board is in the vehicle

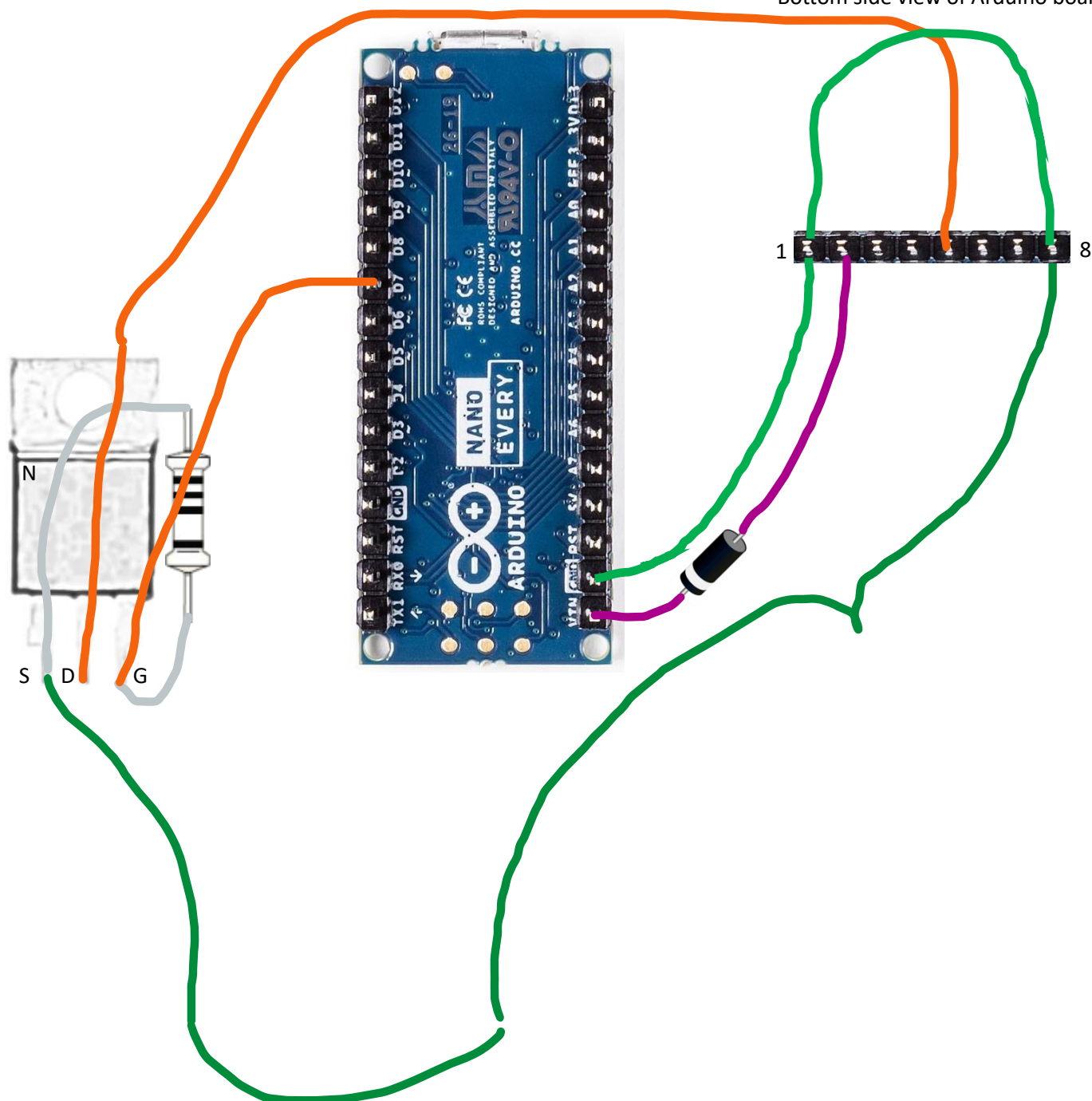


Bottom side view of Arduino board



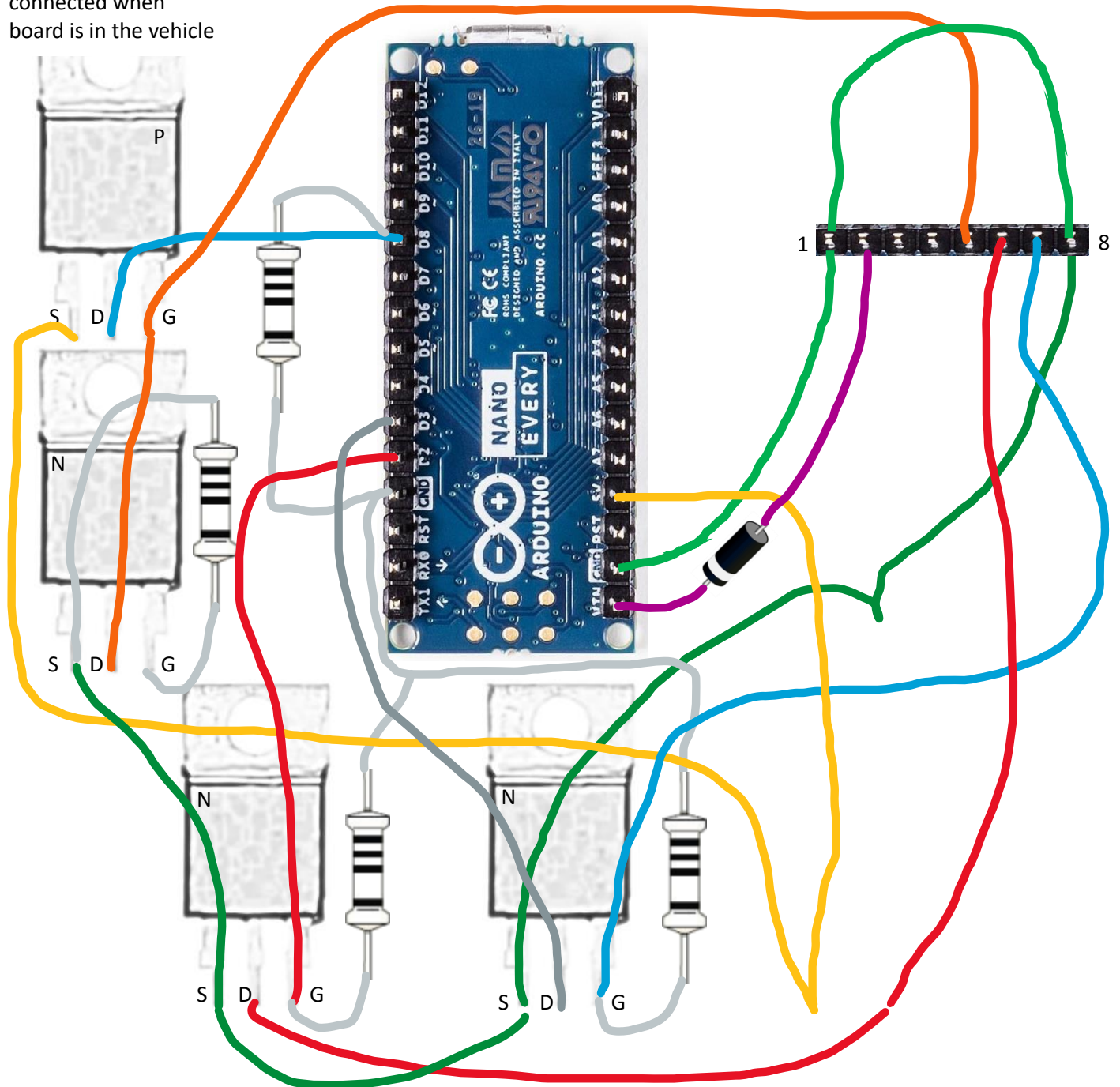
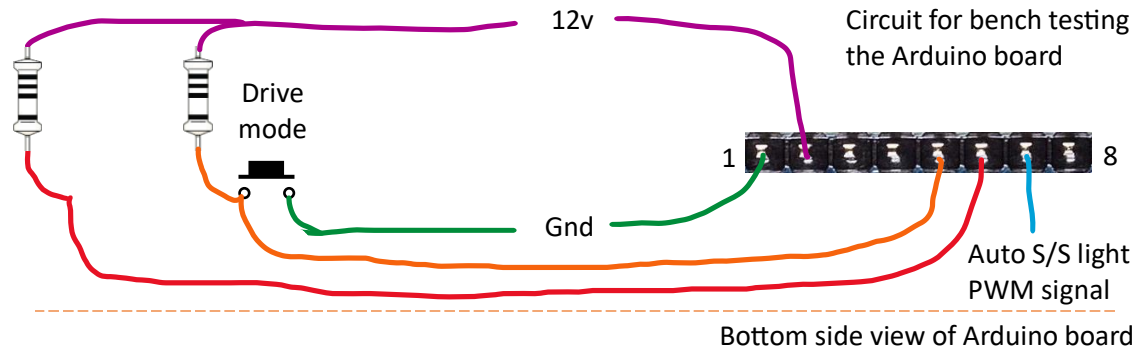
NOTE: Arudino's USB **CAN NOT** be connected when board is in the vehicle

NOTE: Arudino's USB **CAN NOT** be connected when board is in the vehicle



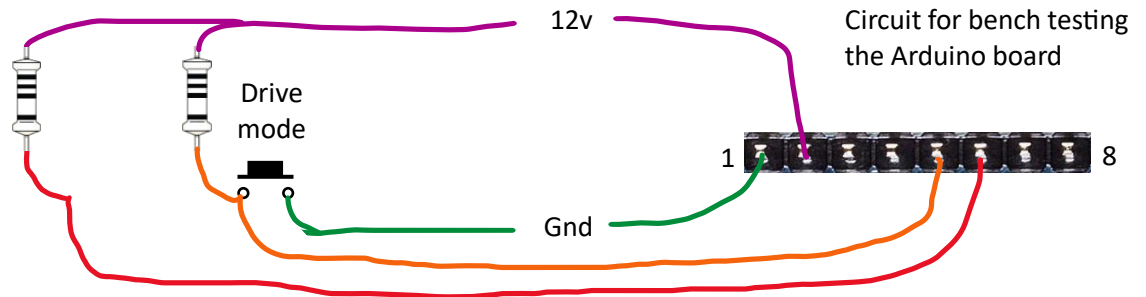
Just Drive Mode Default and Programmable - Remote Start Support

NOTE: Arduino's USB
CAN NOT be
connected when
board is in the vehicle

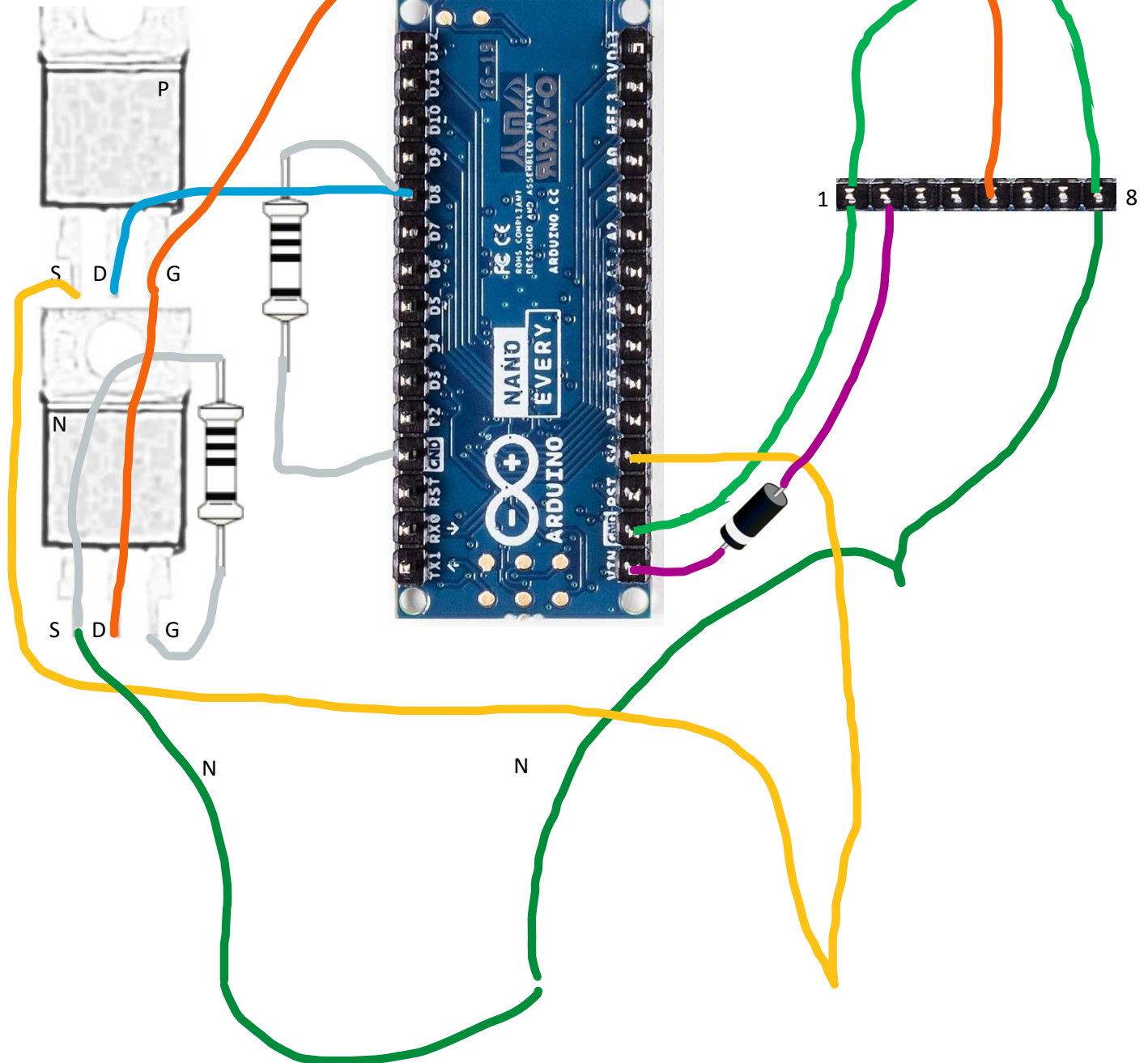


Just Drive Mode Default and Programmable - When Arduino Gets 12v

NOTE: Arduino's USB
CAN NOT be
connected when
board is in the vehicle



Bottom side view of Arduino board



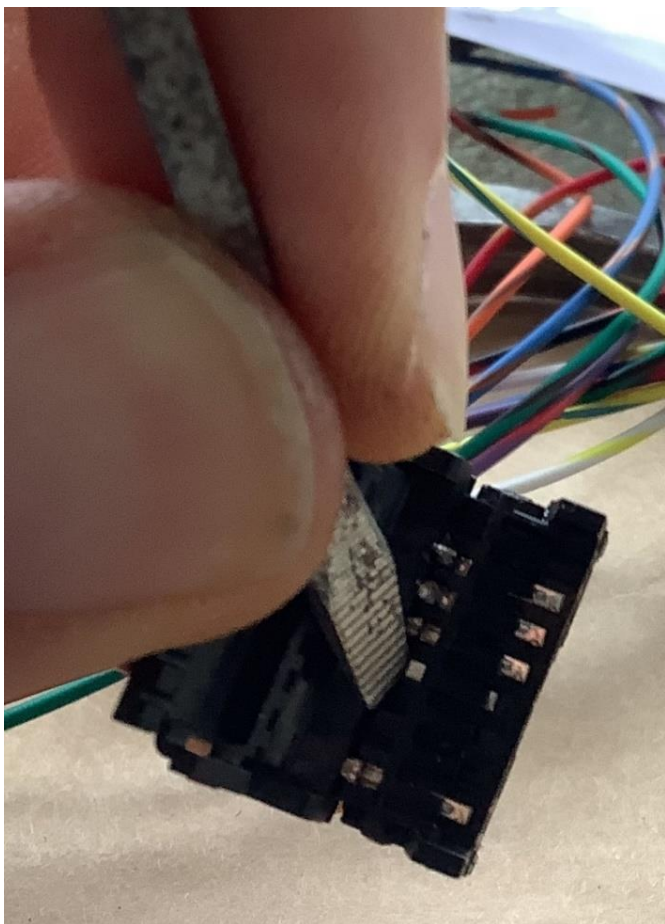
Actual Pictures

Terminal/Pin Crimped and Soldered



Inserting Pin into Female Plug

May need to use a small screwdriver to help get the pin fully inserted.



Wire Harness – In Progress

Wires for Arduino board are spliced from appropriate wires. I soldered the splices and put shrink wrap on them; just be sure to slide on the shrink wrap prior to inserting the terminals/pins into the female plug.

After this I hot glues the wires at the male connector, so they didn't bend and short.



Wire Harness – Completed

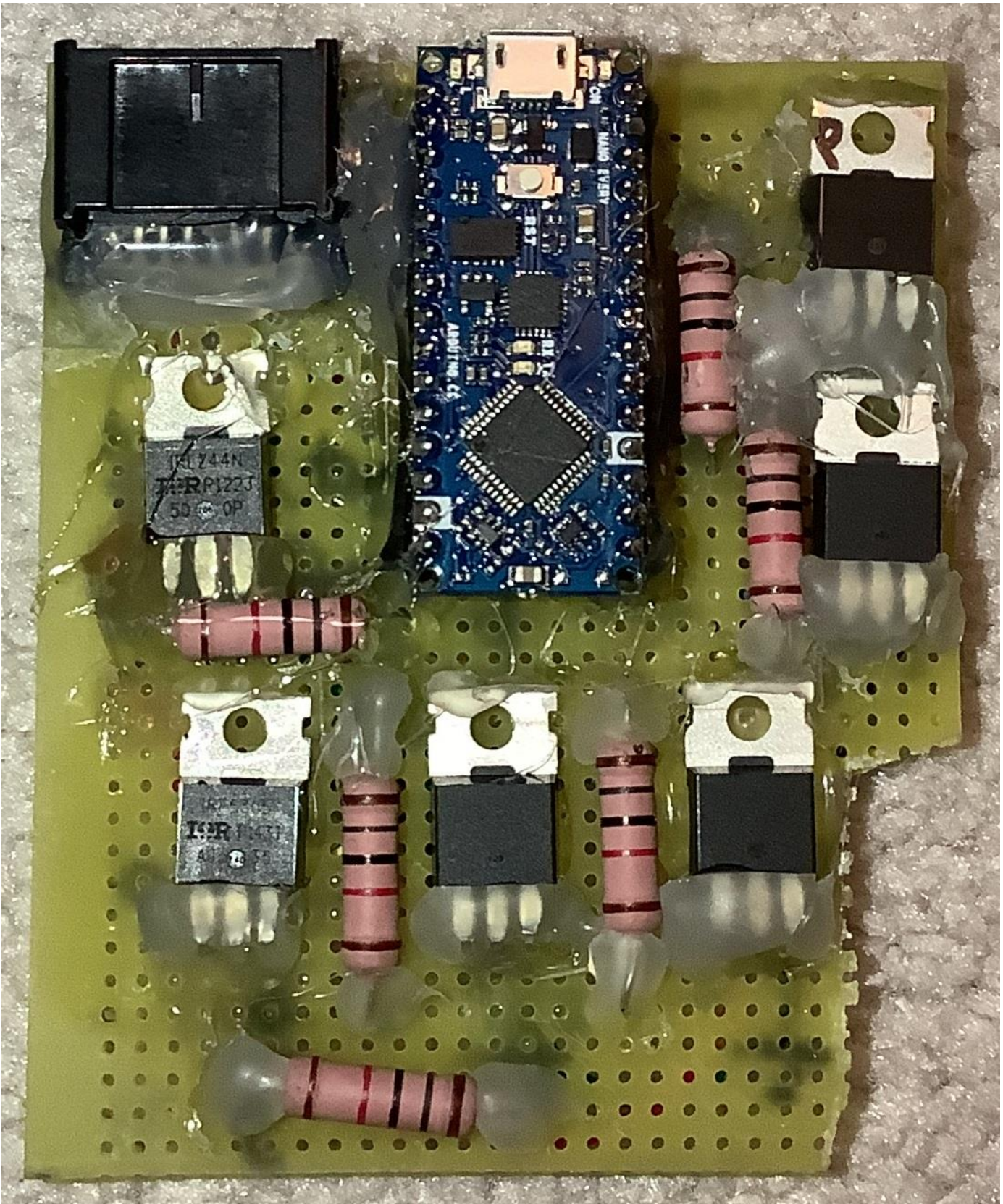
You can see the cloth tape around all the wires.



Arduino Board – Top View

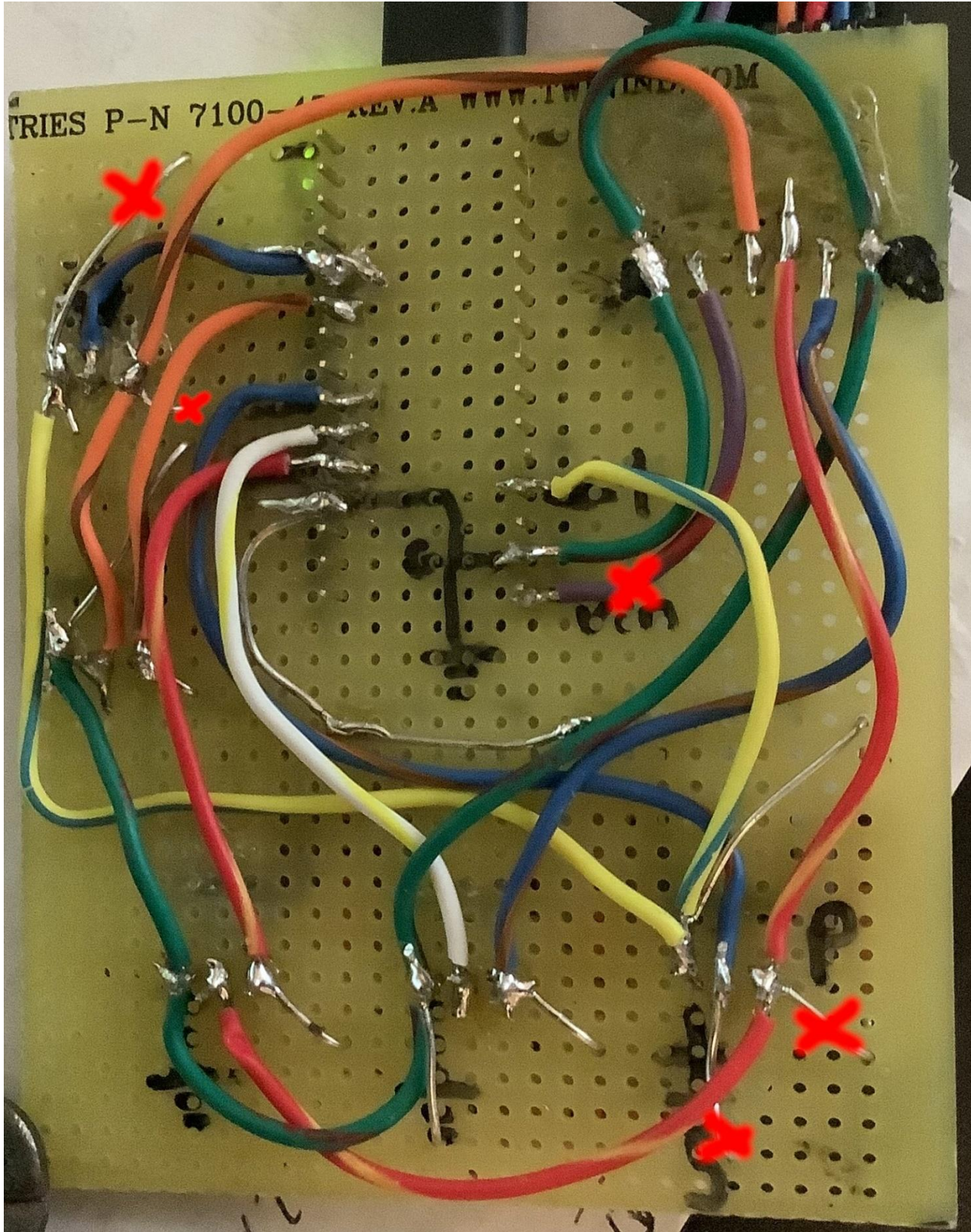
You can see everything hot glued, to help keep things from moving and protect connections from shorts.

The headers are glued to the perf board and wires solder to it. The Arduino is plugged into the headers, making it removable.



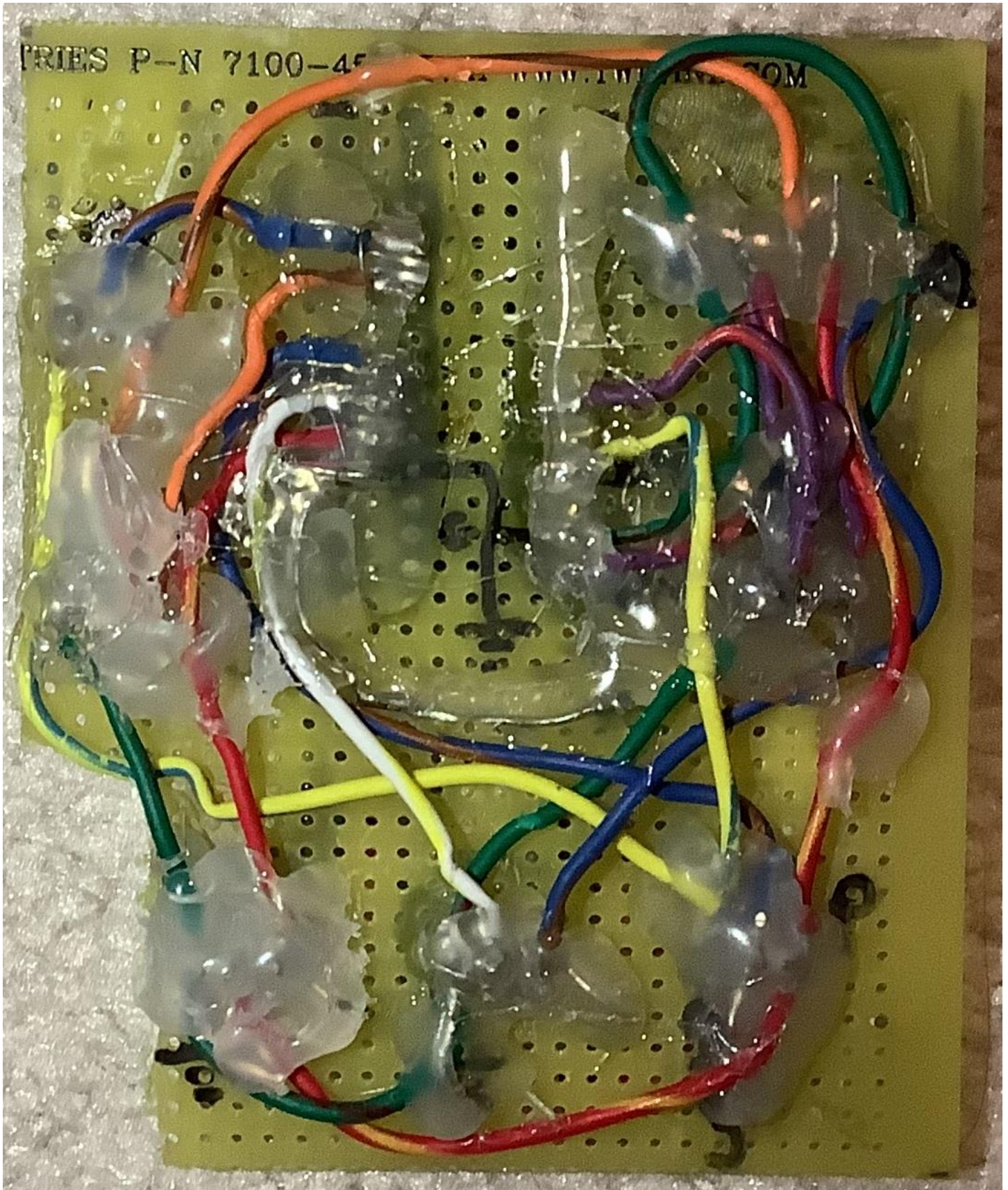
Arduino Board – Bottom View 1 of 2

This is in progress and was before I corrected the Vin power by adding the diode and another Mosfet. There are also two resistors I have removed. I put red X for those items. I'm only including it so you get an idea of what it looks like before the hot glue, this is **NOT** fully accurate.



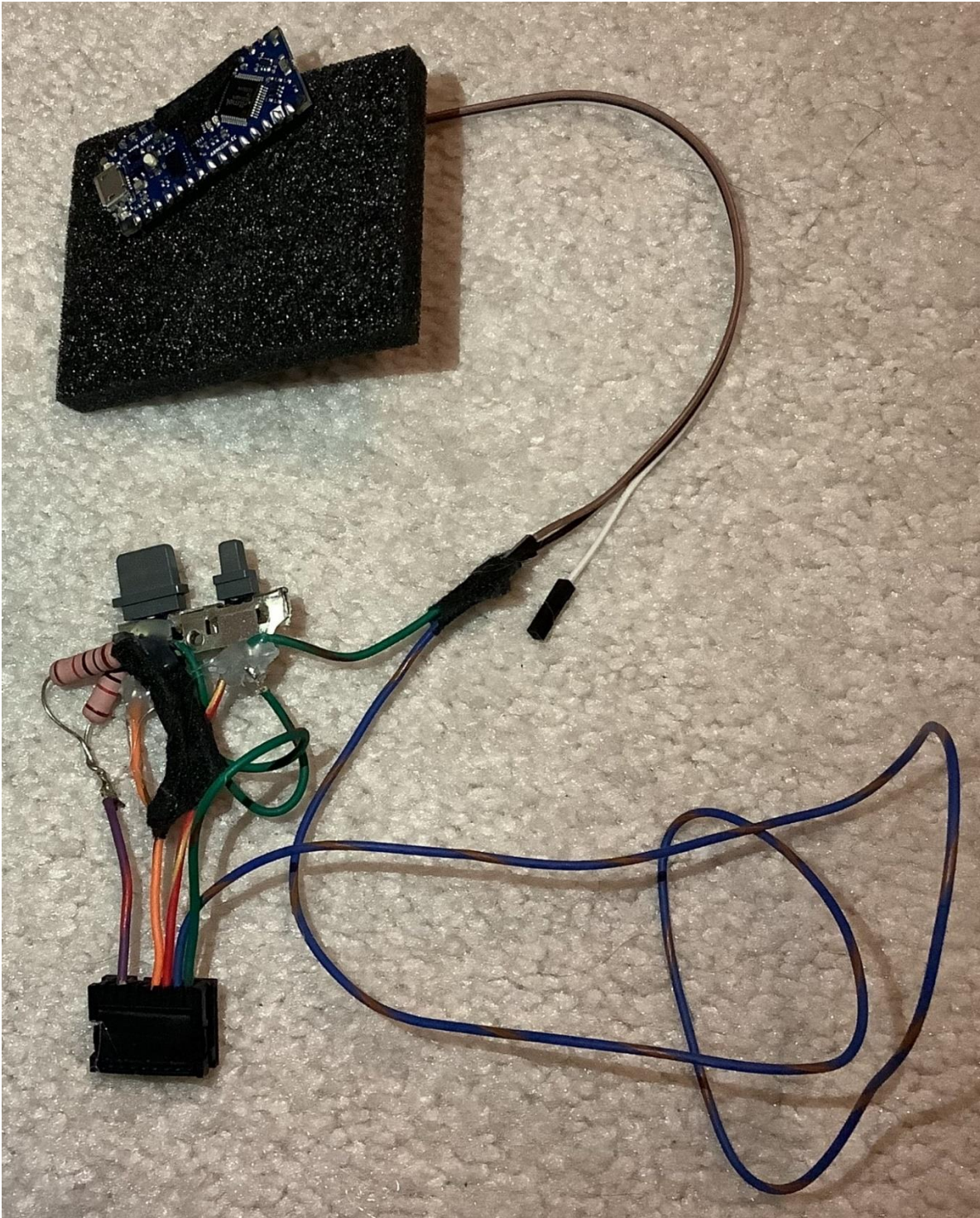
Arduino Board – Bottom View 2 of 2

You can see everything hot glued, to help keep things from moving and protect connections from shorts. This is the view that matches the **Parts Layout** diagrams.



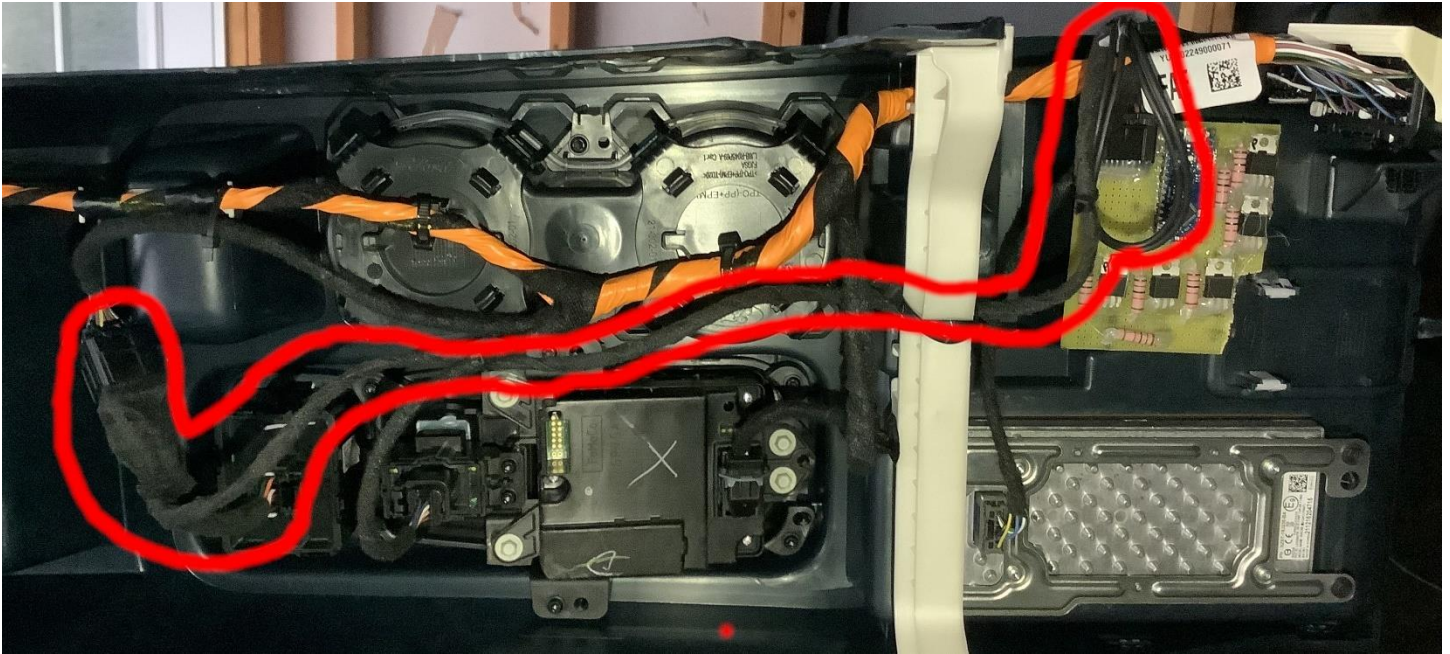
Test Circuit – Simulates Vehicle

I used some momentary switches that I already had. That is a second Arduino running the Auto Start/Stop light simulation code.



Wire Harness Routing - Under Console

It is above that white cross support. It is below the orange wrapped harness and then up the outside of it, with the plug goes above it. Later I added some zip ties to hold it in place.



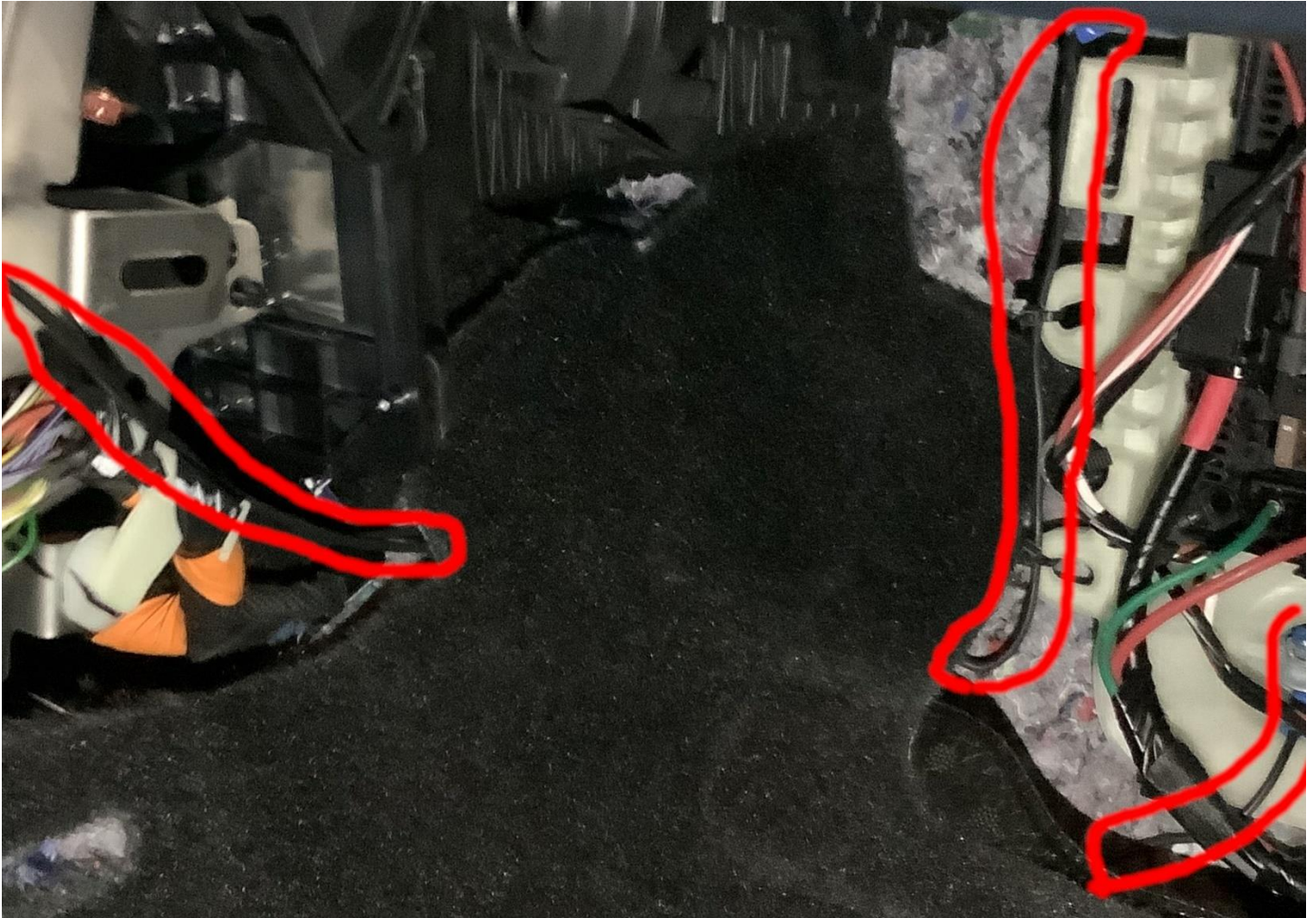
Wire Harness Routing - Console Side View and to Fuse Box Part 1 of 3

The vehicle power connector is above main harness connector and Velcro to hold it in place.



Wire Harness Routing - To Fuse Box Part 2 of 3

It is under the carpet, then the 12v goes up the side of the fuse box and held in place with zip ties. Ground goes to bolt.



Wire Harness Routing - To Fuse Box Part 3 of 3

It is connected to Fuse 3, with 5 amp fuse. It could probably be a lower rating, but that is I had. Ground goes to bolt, which I put a ring terminal on to make it easier..

