

2020 Electrical Design Review

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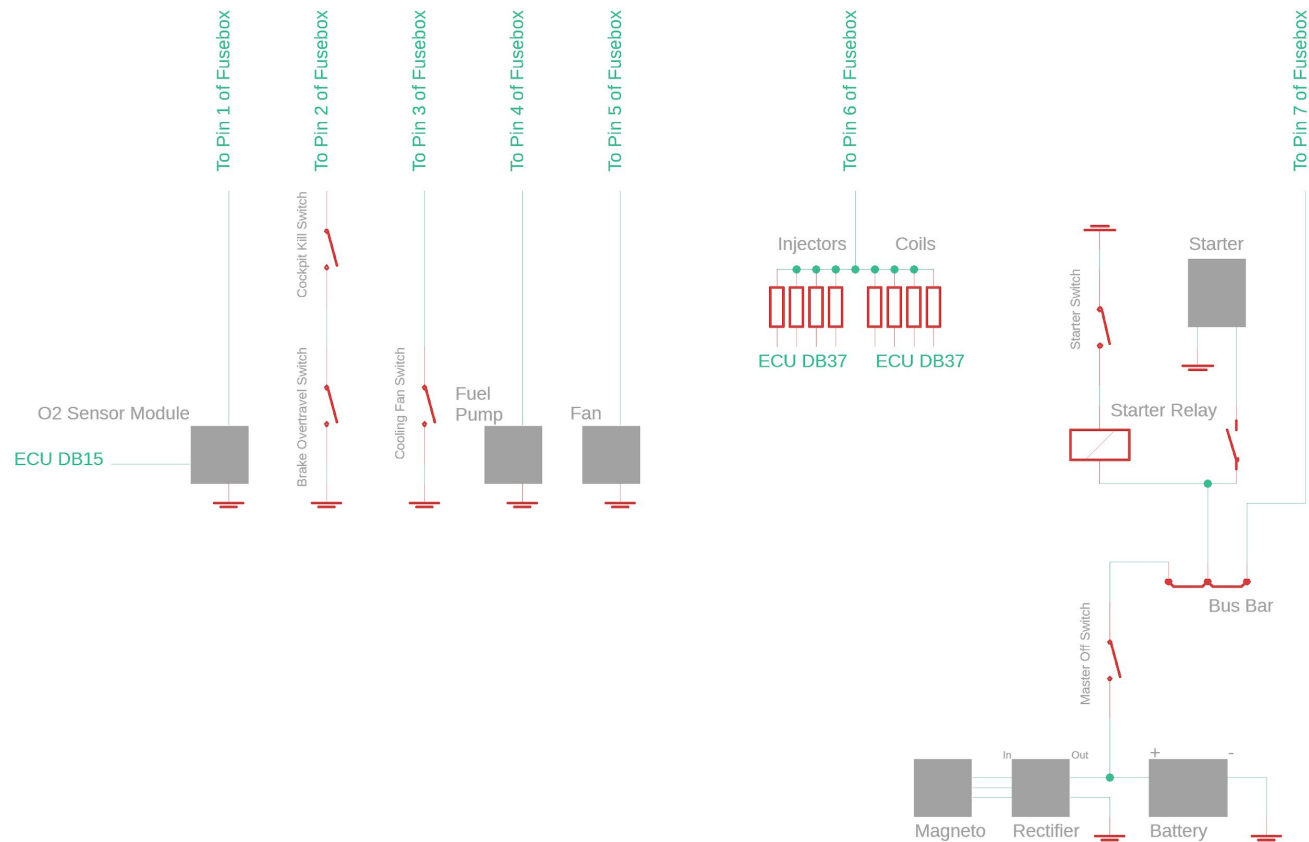




Goals

1. Reduce material costs to fit limited budget
2. Fix ECU issues with proper grounding
3. Reduce complexity with cockpit wiring
4. Reduce complexity and size of harness
5. Improve other shortcomings of 97 including improper arc protection, lack of data acquisition

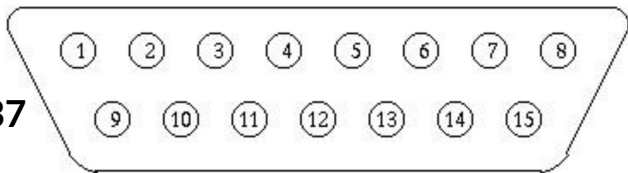
General Schematic



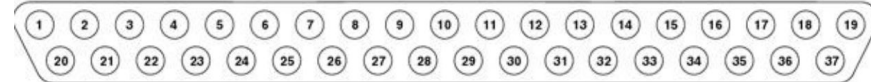
ECU Connections

DB 15

DB 37



Pin Number	Function	Destination
1	IGN 1	Coil Bank
2	None	
3	IGN 2	Coil Bank
4	None	
5	IGN 3	Coil Bank
6	None	
7	IGN 4	Coil Bank
8	None	
9	Ground	Frame Ground Point
10	Ground	Frame Ground Point
11	INJ 1	Injector Bank
12	INJ 2	Injector Bank
13	INJ 3	Injector Bank
14	INJ 4	Injector Bank
15	Ground	Frame Ground Point



Pin Number	Function	Destination
1	Crank sensor ground	Crank Sensor Ground
2	Crank shielded cable ground	Crank Sensor Ground
3	None	
4	None	
5	None	
6	None	
7	IAT, TPS, CLT sensor ground (spliced)	Throttle Body Common Ground
8	None	
9	None	
10	None	
11	None	
12	None	
13	None	
14	None	
15	ECU ground	Frame / Engine Ground Point
16	ECU ground	Frame / Engine Ground Point
17	ECU ground	Frame / Engine Ground Point
18	ECU ground	Frame / Engine Ground Point
19	ECU ground	Frame / Engine Ground Point
20	IAT signal	Throttle Body IAT Signal
21	CLT signal	Throttle Body CLT Signal
22	TPS signal	Throttle Body TPS Signal
23	O2 sensor signal (from o2 sensor module)	O2 Sensor Module Signal
24	Crank sensor signal	Crank sensor Signal
25	None	
26	TPS 5V reference	Throttle Body TPS 5V REF
27	None	
28	ECU power in	Relay Module
29	None	
30	None	
31	None	
32	None	
33	None	
34	None	
35	None	
36	None	
37	None	



Manufacturing Schedule

Harness Design	12.15.2019
Harness Materials Ordered	12.31.2019
PCB Design	12.15.2019
PCB Simulation/Checks	12.25.2019
PCB Ordered	12.31.2019
Final Assembly Manufactured	02.01.2020 (team goal for starting car)
Final Testing and Improvements	03.01.2020



Goal 1: Reduce Cost

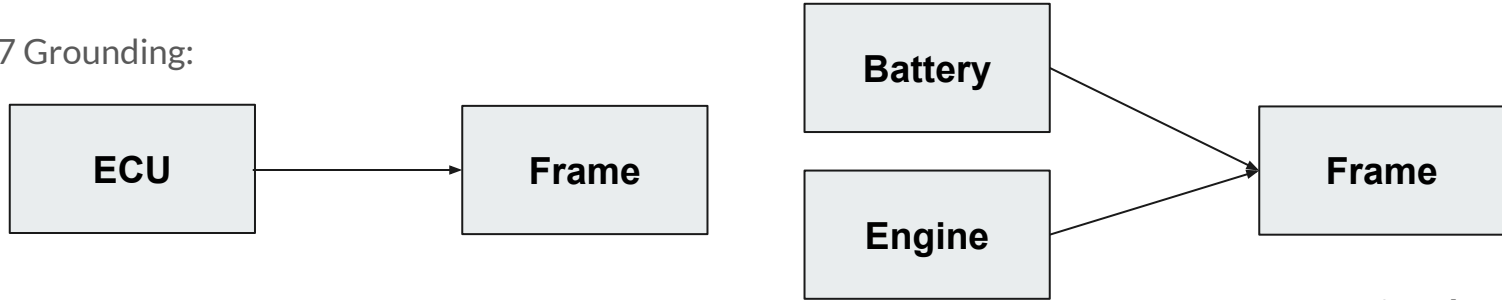
Items re-used from 2018-19 purchases:

- Rectifier
- Injector/Ign Sub-Harness
- Master switches
- Cockpit switches
- Extra Kapton tape
- Extra wiring
- Extra Heat shrink

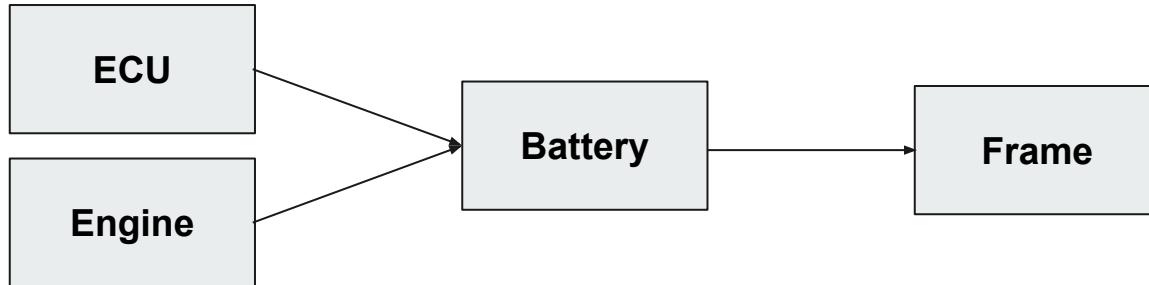
97 Electrical Cost: \$1,576.76 Current Electrical Cost: \$139 Savings: \$1437.76

Goal 2: Fix ECU Issues with Proper Grounding

97 Grounding:



Planned Grounding:



Reason for change:

- Resistance between battery frame ground and ECU frame ground too high
- Thick #2 welding wire better



Goal 3: Reduce Complexity with Cockpit Wiring

- Move fuse/relay box to 'sidepod'
- Custom box next to driver
- Custom pcb for fuses and relays
- Plug for components coming in and out of fuse box

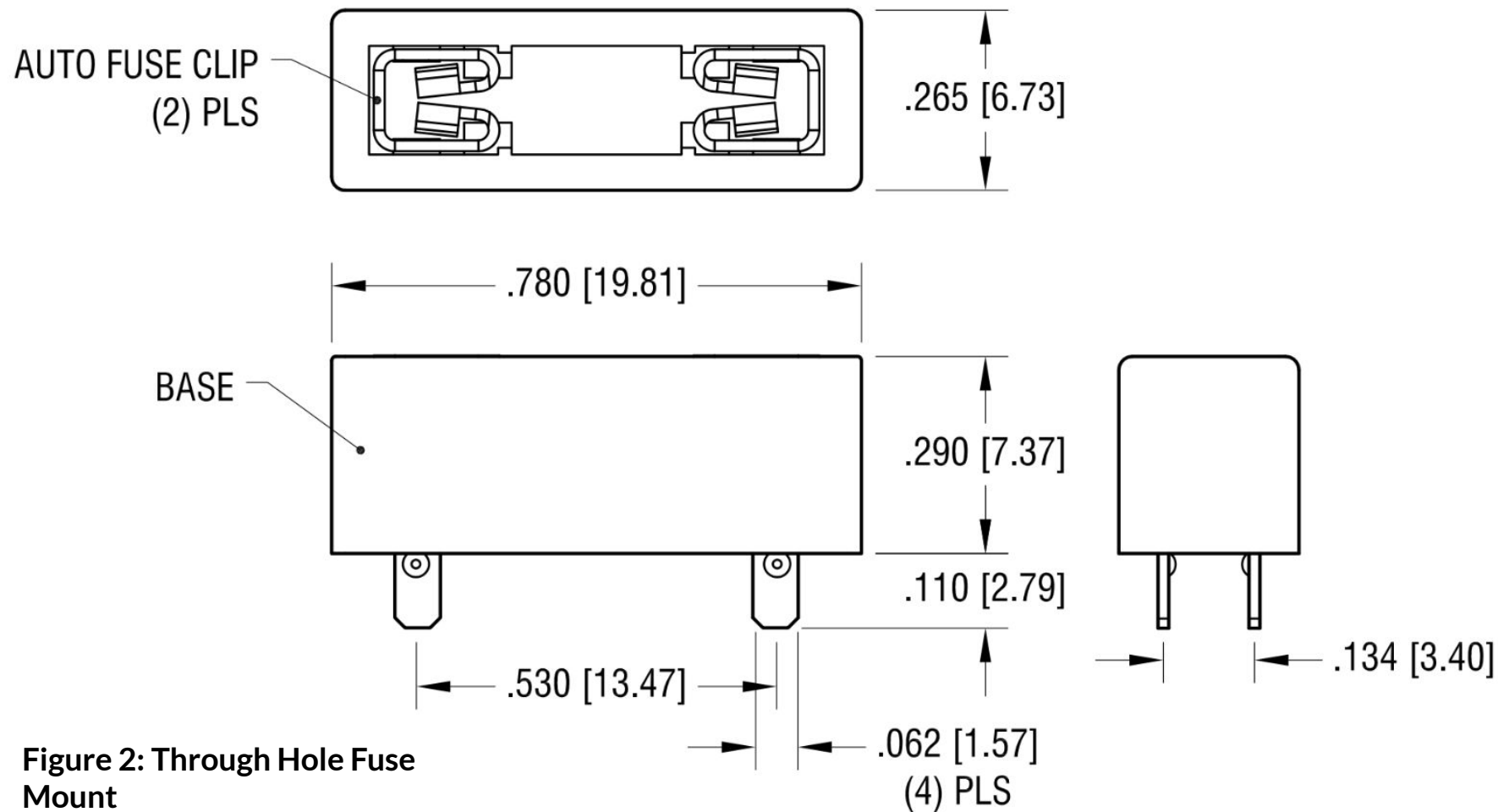


Figure 2: Through Hole Fuse Mount

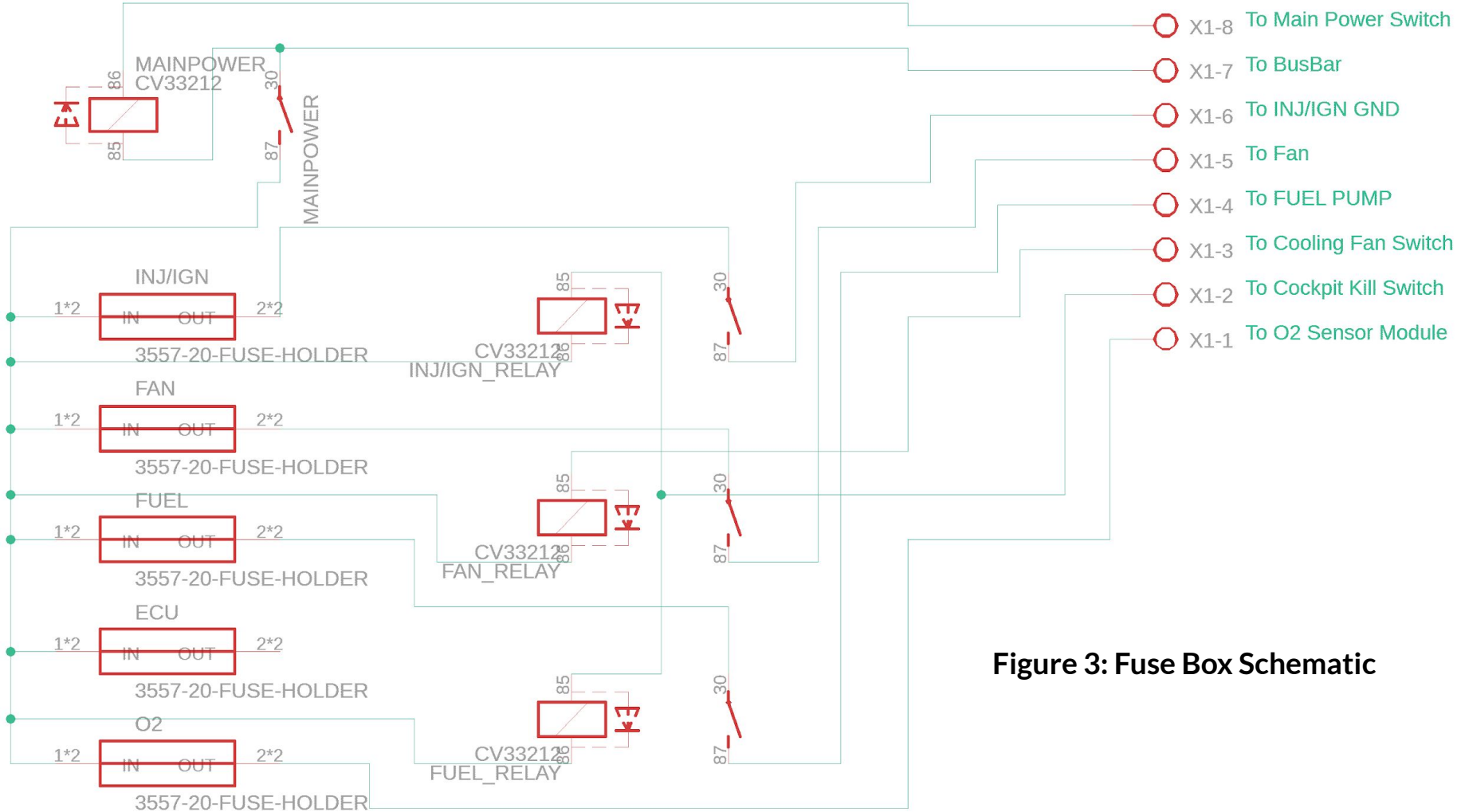
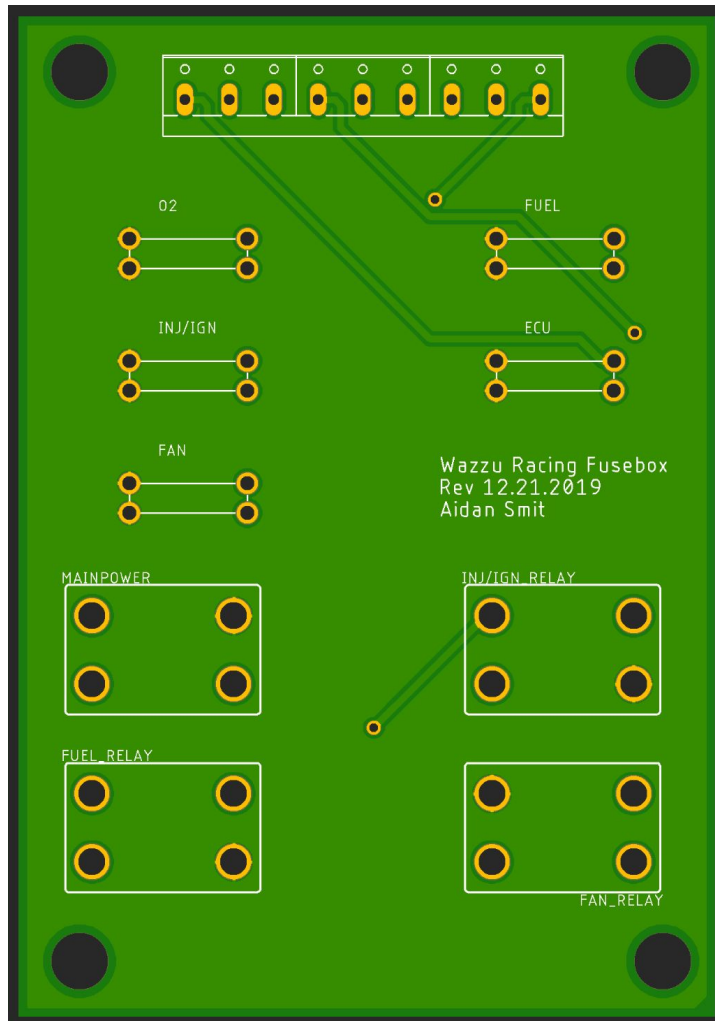
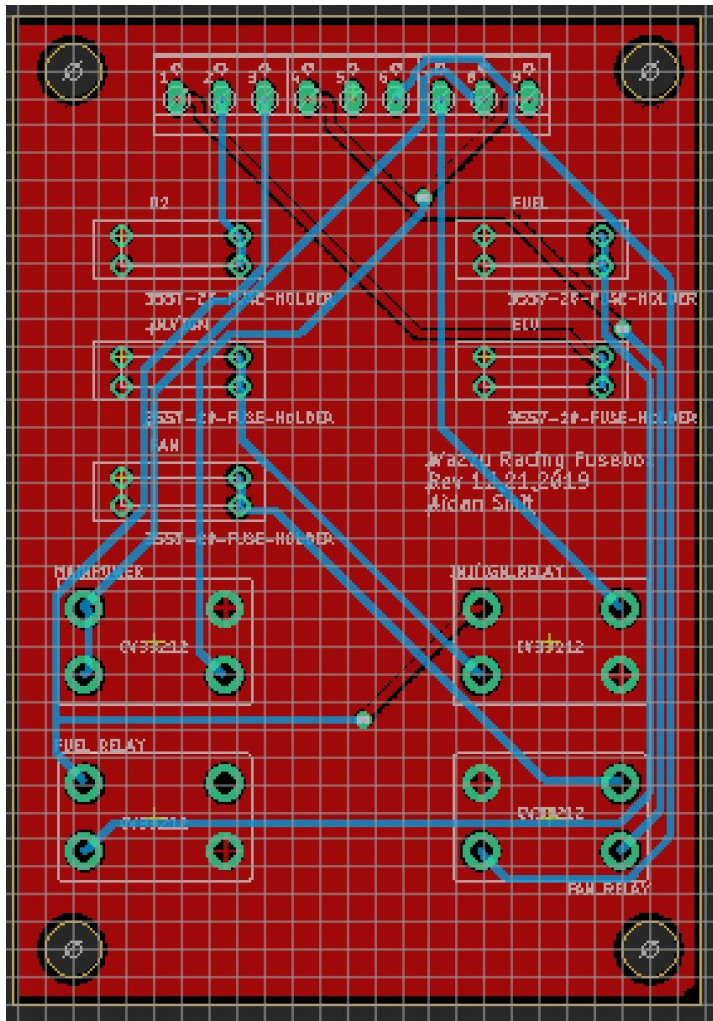


Figure 3: Fuse Box Schematic



**Figure 3: Fuse Box
PCB Design and
render**

Goal 4: Reduce complexity and size of harness

- Using XT30 connectors to shrink down the size of the harness.
- Same connectors used in drones, RC planes, etc.
- Easy to waterproof
- Cheaper than old weather pack connectors
- Using thinner gauge wire for injectors and coils because we overestimated their size last time (18 gauge instead of 10 gauge)





Goal 5: Improve other 97 car shortcomings

- Lack of data acquisition during competition
 - Integration of electrical system with 2 Arduinos and Raspberry Pi
 - See Data Acquisition design presentation with for more info
- Arc protection
 - More custom 3d printed bolt caps for insulation
 - Not forgetting bus bar plastic cover this year
 - Proper heat shrinking on ALL wires
- Complimentary system
 - Main electrical system, data acq., TCU, other subsystems all properly integrated
 - Dependent, but one system failing will not kill the rest of the system
 - Each component removable, replaceable
- Color Coding
 - Can't afford to color code wires or outer heat shrink, so we will color code heat shrink at the connectors
 - Simple, yet effective

Thank you!
Any Questions?
