WISCONSIN RACING
223C ELECTRICAL DESIGNS

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Public Release Foreword

Overview

This is an overview of the unique electrical designs for the 2023 Combustion FSAE car from Wisconsin Racing (UW-Madison). Some of the combustion car's designs are not documented here, and can be found in the electric car documentation, found here https://www.wisconsinracing.org/e-documents/. This "design binder" is what we prepared for the competition's design event. Wisconsin Racing's previously-released design documentation on our website (https://www.wisconsinracing.org/e-documents/) have been a useful reference for other teams looking to design custom hardware. In that spirit, we are releasing the designs of the entire electrical system of both our 2023 electric and combustion vehicles, including our BMS, inverter, steering wheel electronics, LV power distribution, and more.

Correctness, Iteration and Rules Changes

This is a snapshot of the state of these designs last year, and all of them are being improved this year. Therefore, the correctness and rules compliance of these designs cannot be guaranteed. Some designs call out problems found within the design, just referencing schematics may lead to missing those callouts.

Custom System Notes

Wisconsin Racing has a highly custom electronics system, and it has not been sunshine and rainbows to get to this point. It has been a 7-year team effort. If you're a new team, it is more important to have a car that moves than a car with a bunch of custom PCBs. Don't underestimate the challenge of designing reliable and rules-compliant hardware.

2023 Combustion Competition Results

Event	Placement
Design	12th
Acceleration	31st
Skidpad	67th
Autocross	44th
Efficiency	DNF
Endurance	DNF (0 laps completed)
Overall	56th

Incompleteness/ Systems Integration

This document is incomplete in that it is missing many details of integration, manufacturing and testing. The document is mostly focused on the design of the custom PCB systems on the car, which is not what makes a team win. Reliability and a well tested car wins competitions, not the fancy circuit boards.

Special Thanks

This document and the 2023 race cars would not be possible without the many contributions of the engineers who worked on it and the alumni that set the stage for this car. I would also like to thank the mentors from the 2022 season, Quinn Sabin, Kai Linsenmeyer and Evan Wildenberg. Special thanks to Alex Groteluschen (High Voltage Lead) as he helped spearhead the creation, formatting and push for this document. Isaac Hewett was my counterpart on the mechanical side, and none of this would be possible without the car to put the electronics in (be nice to your mechanical engineers). Thank you to the subsystem leads and all the team members that put in a large amount of effort to make this document and this car:

- Alex Groteluschen, High Voltage Lead
- Calvin Geishirt, Low Voltage Co-lead
- Pratham Sarvaiya, Low Voltage Co-lead
- Shrey Patel, Controls Co-lead
- Surya Raghavendran, Controls Co-lead
- Eric Li, Firmware Co-lead
- Sean Staggs, Firmware Co-lead

Additionally, thank you to our sponsors who can all be found on the website. The sponsors take the idea of a car and help turn it into the real thing. Finally, thank you to our faculty advisor, Glenn Bower whose wisdom and assistance has kept these cars being built year after year.

Questions/Contact Information

From my personal experience, being in charge of the electrical system of two race cars is an extraordinary challenge, and documentation may not be readily available. If you have questions, feel free to email me at christian@lastlock.com or add and message me on LinkedIn. I may not have the answer, but I will attempt to find someone who does, or provide some direction.

Thank you and good luck designing,
Christian Schuster
2023 Electrical Technical Director for Wisconsin Racing

Team Photo

Car Photo

DynoPDU

Engineer: Calvin Geishirt, LV Electronics Lead
Revision 2023.1
Dimensions: 100mm x 110mm
Steady State Current Draw: 50mA

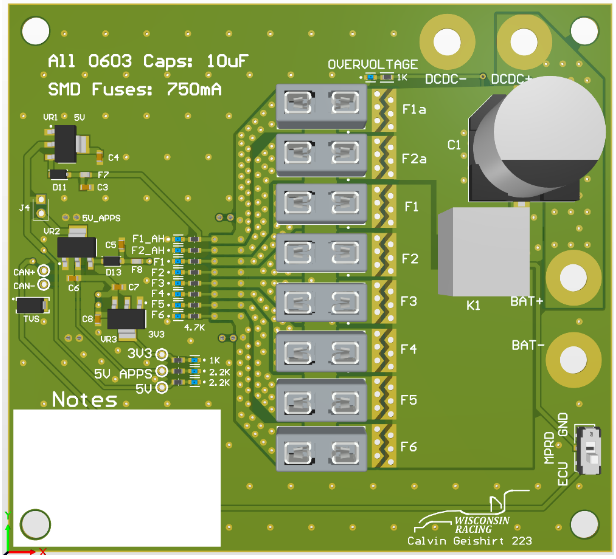
Overview

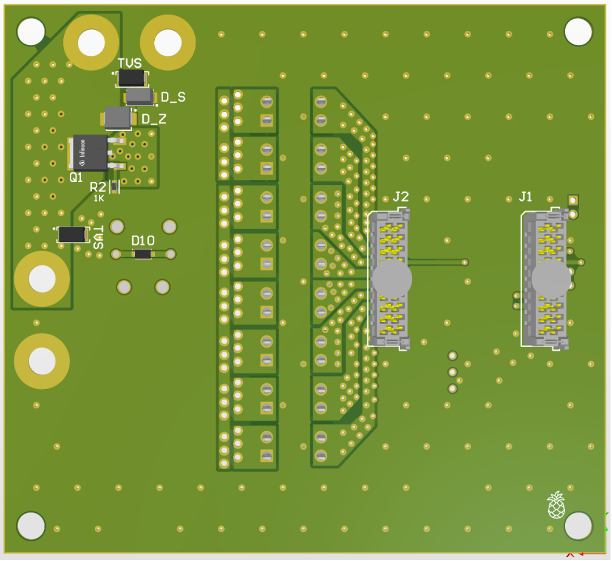
The goal of this design was to have a simple and reliable power distribution unit (PDU) to aid the development process of our cars. This board mates with the CCar Carrier board or the ECar Battery Main board and is a fully functional drop-in replacement for our Smart Power Distribution Unit (see ECar Documentation section for more details). While this design is relatively simple, the reasons for making it were very clear and important:

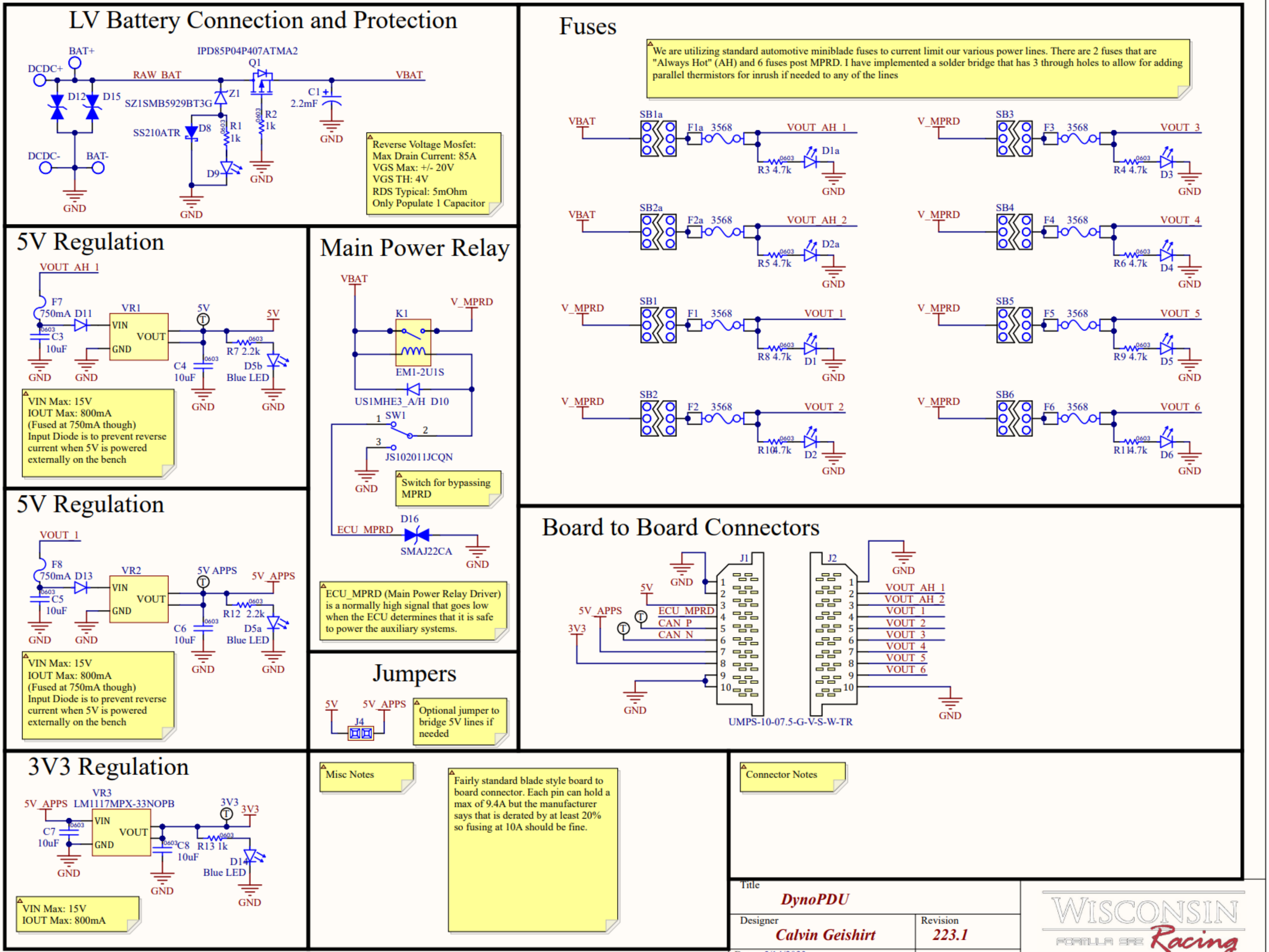
- We needed to have a simple and reliable PDU done by September 1st for engine dyno development.
- Having the design early also allowed us to easily rapid-prototype the carrier board which ended up needing a few revisions.
- Having a blade fuse design allows for more accurate electrical characterization of our system without any smart circuitry interfering with measurements
- The DynoPDU is very robust and is fast, easy, and cheap to fix or fully assemble compared to our SmartPDU. This meant that we were able to use the DynoPDU during times in development that may put the SmartPDU at risk.
- The DynoPDU is also a drop in replacement for the SmartPDU on both cars, and uses standard automotive blade fuses that could be easily found at a parts store, or borrowed from our personal cars in the parking lot in a worst case scenario.

Features:

- Reverse and overvoltage protection
- Optional inrush protection via ntc thermistors
- Standard automotive blade fuses
- 5V and 3V3 LDOs







LV Battery Connection and Protection

Reverse Voltage Mosfet:
Max Drain Current: 85A
VGS Max: +/- 20V
VGS TH: 4V
RDS Typical: 5mOhm
Only Populate 1 Capacitor

Fuses

We are utilizing standard automotive miniblade fuses to current limit our various power lines. There are 2 fuses that are "Always Hot" (AH) and 6 fuses post MPRD. I have implemented a solder bridge that has 3 through holes to allow for adding parallel thermistors for inrush if needed to any of the lines

5V Regulation

VIN Max: 15V
IOUT Max: 800mA
(Fused at 750mA though)
Input Diode is to prevent reverse current when 5V is powered externally on the bench

Main Power Relay

Switch for bypassing MPRD

ECU_MPRD (Main Power Relay Driver) is a normally high signal that goes low when the ECU determines that it is safe to power the auxiliary systems.

Board to Board Connectors

5V Regulation

VIN Max: 15V
IOUT Max: 800mA
(Fused at 750mA though)
Input Diode is to prevent reverse current when 5V is powered externally on the bench

Jumpers

Optional jumper to bridge 5V lines if needed

3V3 Regulation

VIN Max: 15V
IOUT Max: 800mA

Misc Notes

Fairly standard blade style board to board connector. Each pin can hold a max of 9.4A but the manufacturer says that is derated by at least 20% so fusing at 10A should be fine.

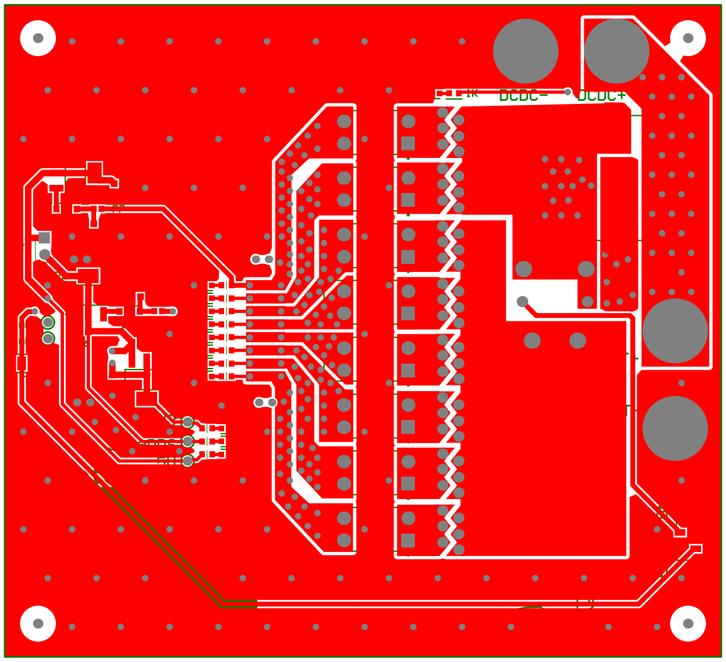
Connector Notes

Title	
DynoPDU	
Designer	Revision
Calvin Geishirt	223.1
Date: 5/14/2023	
File: 223_DynoPDU.SchDoc	

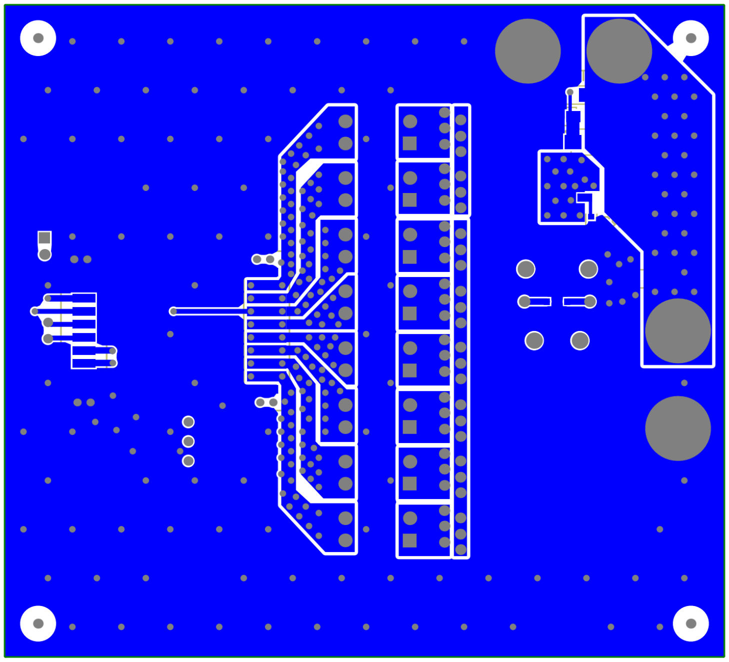
WISCONSIN FORMULA SAE Racing

PCB Layers

Top Layer



Bottom Layer

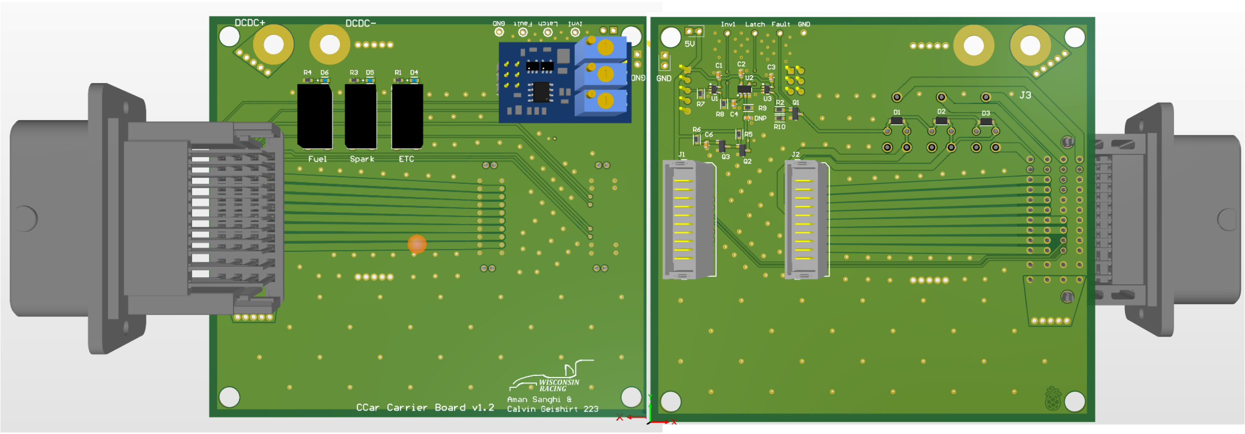


C-Car Carrier Board

Engineer: Calvin Geishirt, LV Electronics Lead
Revision 2023.2
Dimensions: 110mm x 100mm
Steady State Current Draw: 110mA

Overview

The C-Car Carrier Board was a new design this year to allow for complete compatibility of our Power Distribution Unit (PDU) between our electric and combustion cars. It's main purpose is to house our Brake System Plausibility Device (BSPD) with its non-programmable logic circuitry, Electronic Throttle related Power Relays for the BSPD to control, as well as passing power and signals between the PDU and the rest of the car. Separating out the combustion car specific circuitry also allows for space saving on the electric car, as well as easy rapid iteration on the combustion car while retaining the use of our current PDU.

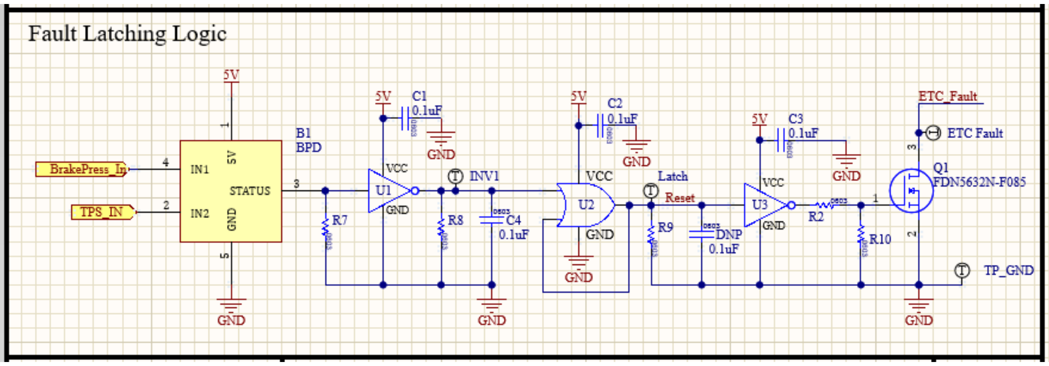


C-Car Carrier Board PCB Layout top and bottom

Features:

- Houses BSPD with latching logic circuitry
- Houses Power Distribution Unit
- ETC Power Relays
- 48 Pin Molex Connector

BSPD Logic Circuitry



Operation

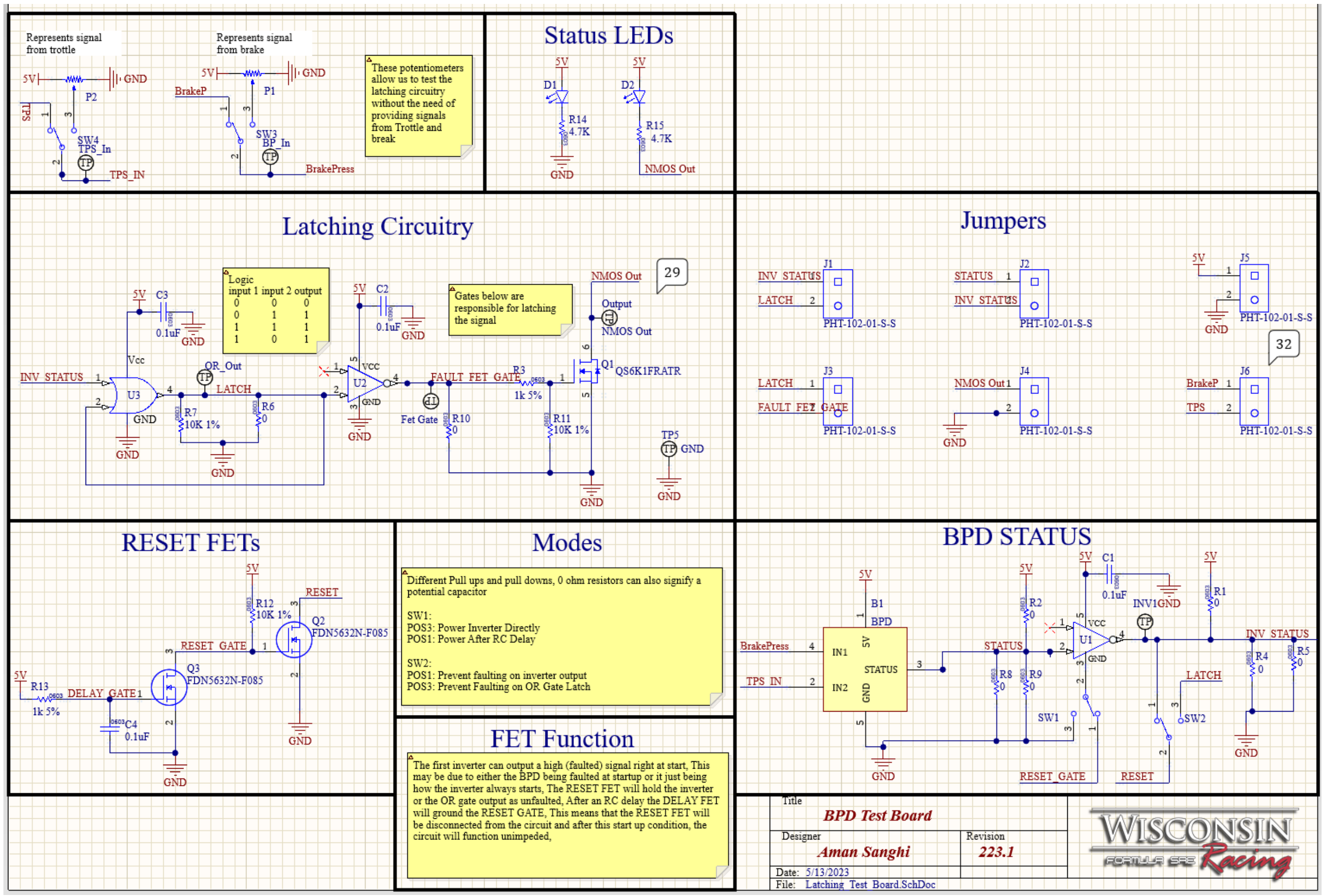
Our BSPD operates such that a low signal means that it is faulted so that if it were to lose power, the system would operate as though a fault condition was present. Using simple logic gates, we first send the BSPD fault signal to a NOT gate which would turn a faulted low signal into a high signal. That high signal would then go to an AND gate, with its output fed back into one of its inputs, which is how the system stays in a latching fault state because if the BSPD were to become un-faulted, the AND gate feedback would keep the system faulted. The AND gate output is then fed into a final NOT gate that controls an n-channel mosfet that acts as a low side switch for the relay coils of our Ignition, Throttle, and Fuel Pump.

Molex Connector

We chose this connector because it is the same style as the connectors we use for our vehicle controller. Using a common connector reduces the number of different types of pins and tools that we need to have with us at all times and streamlines the process of creating wiring harnesses. This connector has 48 contacts, 8 of which are rated for 13A, and 40 rated for 6A.

Latching Test Board

Our first attempt at the latching logic circuitry failed due to startup issues. We made a test board that was modular to allow us to ensure that the next revision would pass all tests.



These potentiometers allow us to test the latching circuitry without the need of providing signals from Trottle and break

Logic		
input 1	input 2	output
0	0	0
0	1	1
1	1	1
1	0	1

Gates below are responsible for latching the signal

Different Pull ups and pull downs, 0 ohm resistors can also signify a potential capacitor

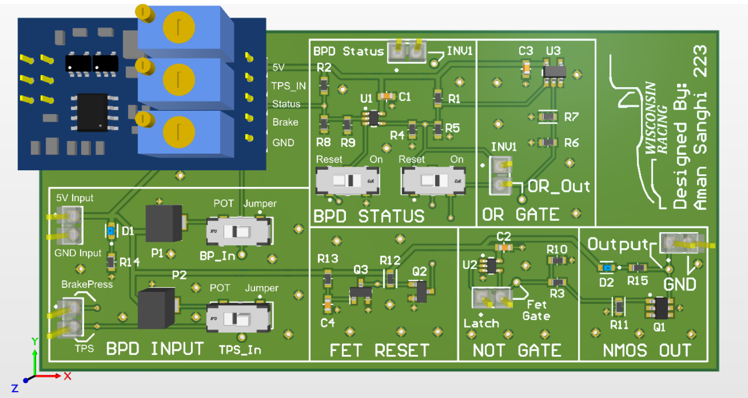
SW1:
POS3: Power Inverter Directly
POS1: Power After RC Delay

SW2:
POS1: Prevent faulting on inverter output
POS3: Prevent Faulting on OR Gate Latch

The first inverter can output a high (faulted) signal right at start, This may be due to either the BPD being faulted at startup or it just being how the inverter always starts, The RESET FET will hold the inverter or the OR gate output as unfaulted, After an RC delay the DELAY FET will ground the RESET GATE, This means that the RESET FET will be disconnected from the circuit and after this start up condition, the circuit will function unimpeded,

Title: BPD Test Board
Designer: Aman Sanghi
Revision: 223.1
Date: 5/13/2023
File: Latching_Test_Board.SchDoc

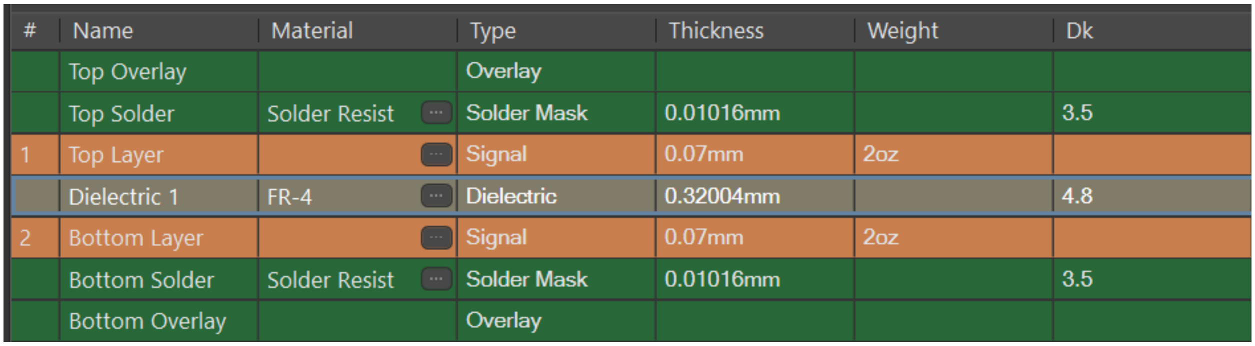
This test board allowed us to quickly test potential solutions to the startup problem. We landed on the solution that is implemented above.



Layout Notes

The size of the board (110mm x 100mm) was chosen to match the size of the Power Distribution Unit that will sit above it. A two layer stackup was used with no issues of fitting all the circuitry on the board.. A 2 oz outer copper weight was used to make high current trace size manageable.

Manufactured by JLCPCB

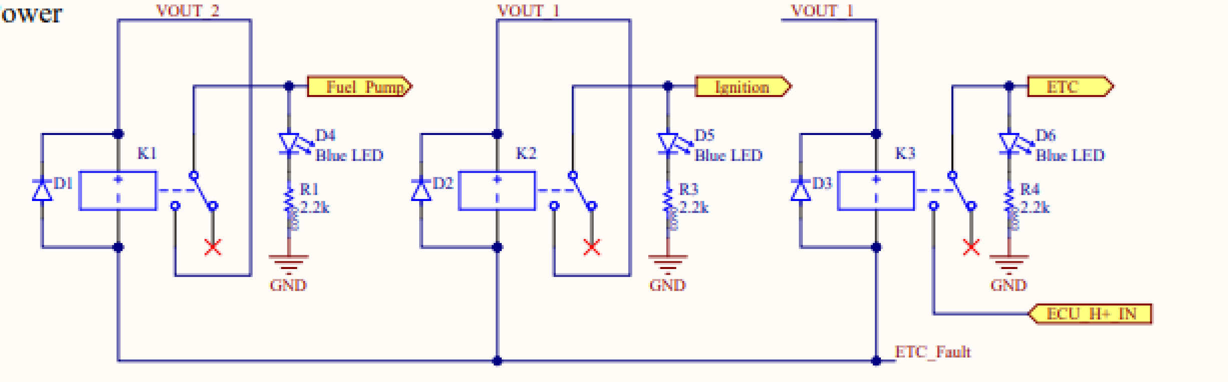


#	Name	Material	Type	Thickness	Weight	Dk
	Top Overlay		Overlay			
	Top Solder	Solder Resist	Solder Mask	0.01016mm		3.5
1	Top Layer		Signal	0.07mm	2oz	
	Dielectric 1	FR-4	Dielectric	0.32004mm		4.8
2	Bottom Layer		Signal	0.07mm	2oz	
	Bottom Solder	Solder Resist	Solder Mask	0.01016mm		3.5
	Bottom Overlay		Overlay			

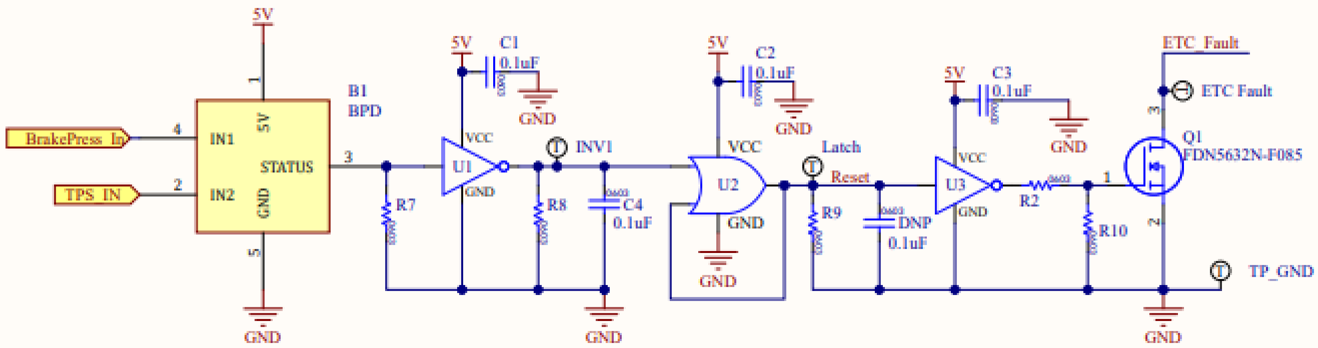
WR1

WR Logo

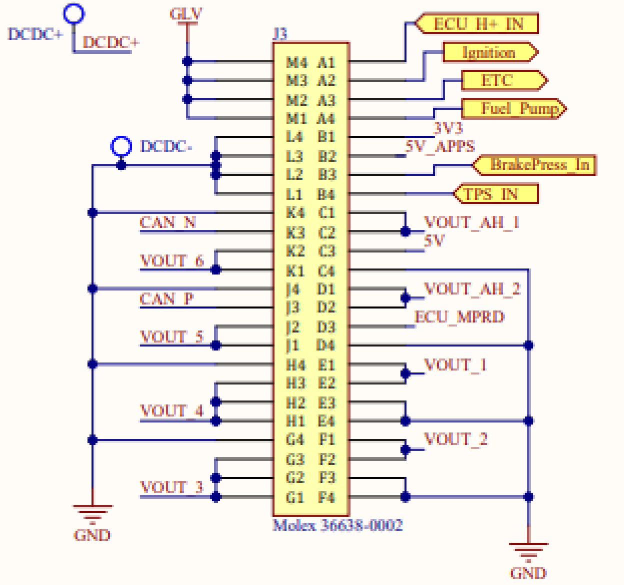
ETC Power



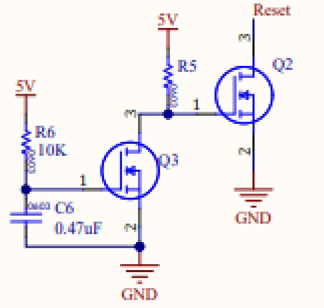
Fault Latching Logic



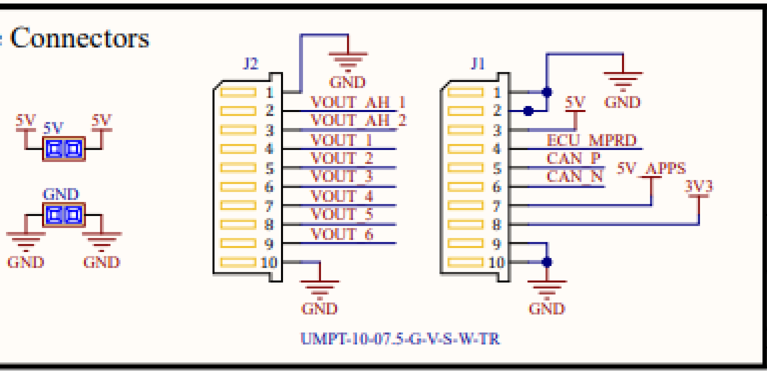
Molex Connector



Power On Reset



Blade Connectors



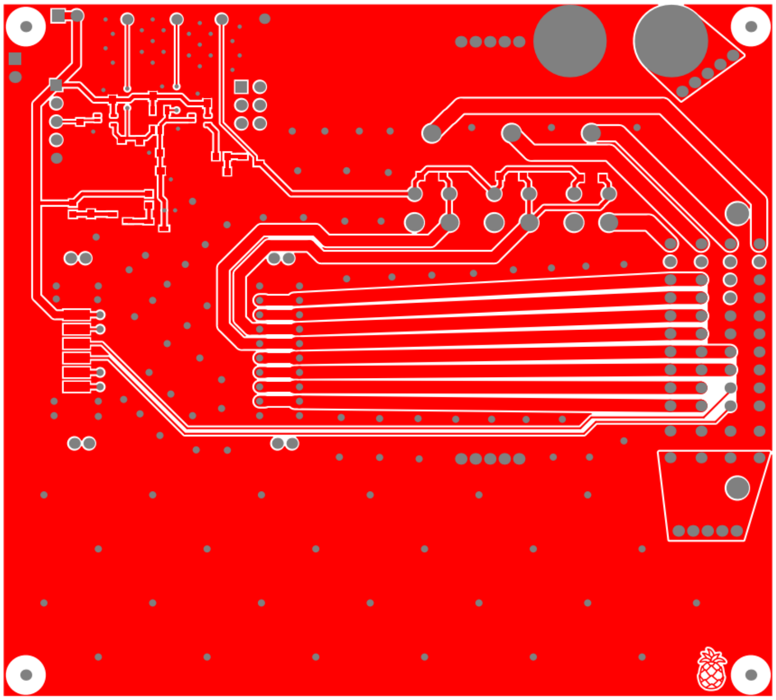
Title	
CCar Carrier Board	
Designer	Revision
Calvin Geishirt	223.1

Date: 5/15/2023

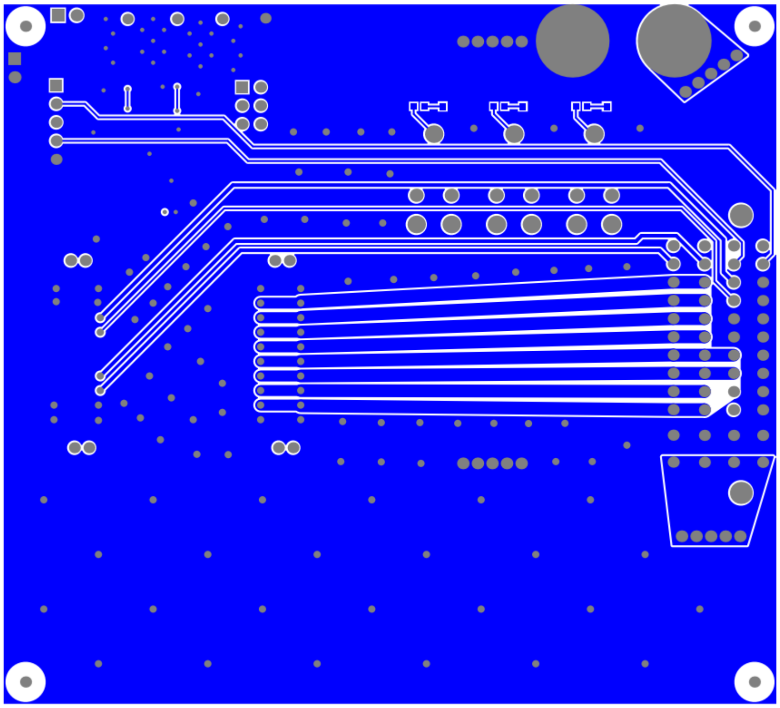
File: Carrier Board v2.SchDoc

PCB Layers

Top Layer



Bottom Layer



Eddy Current Dynamometer

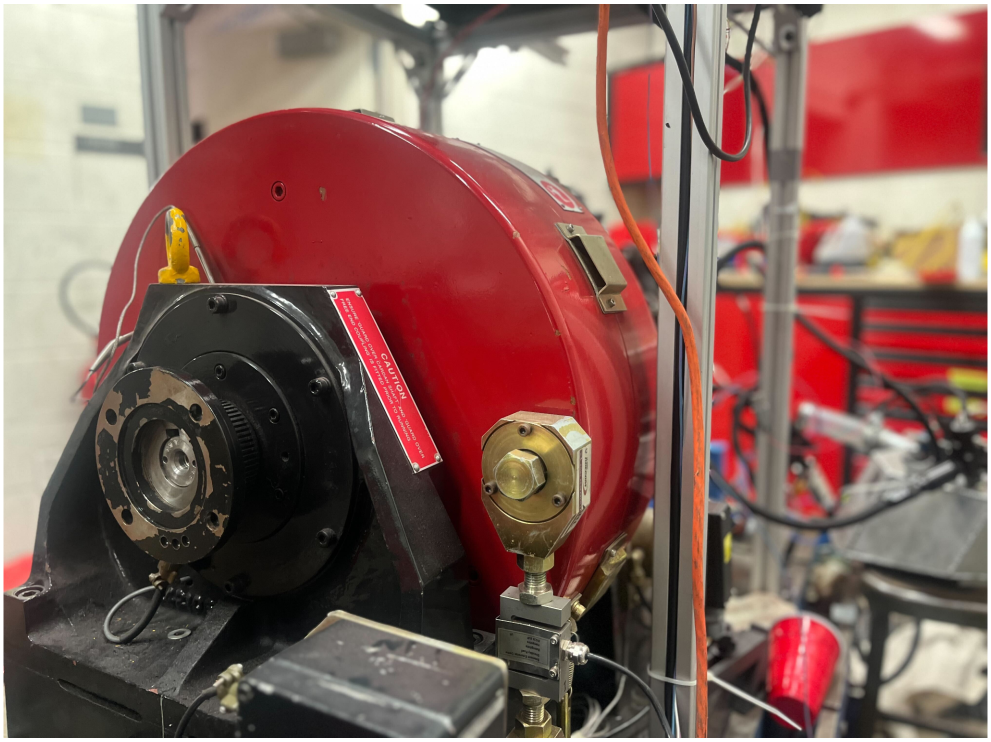
Engineers: Shrey Patel, Controls Lead and Romit Bhatnagar, Controls Team Member

Overview

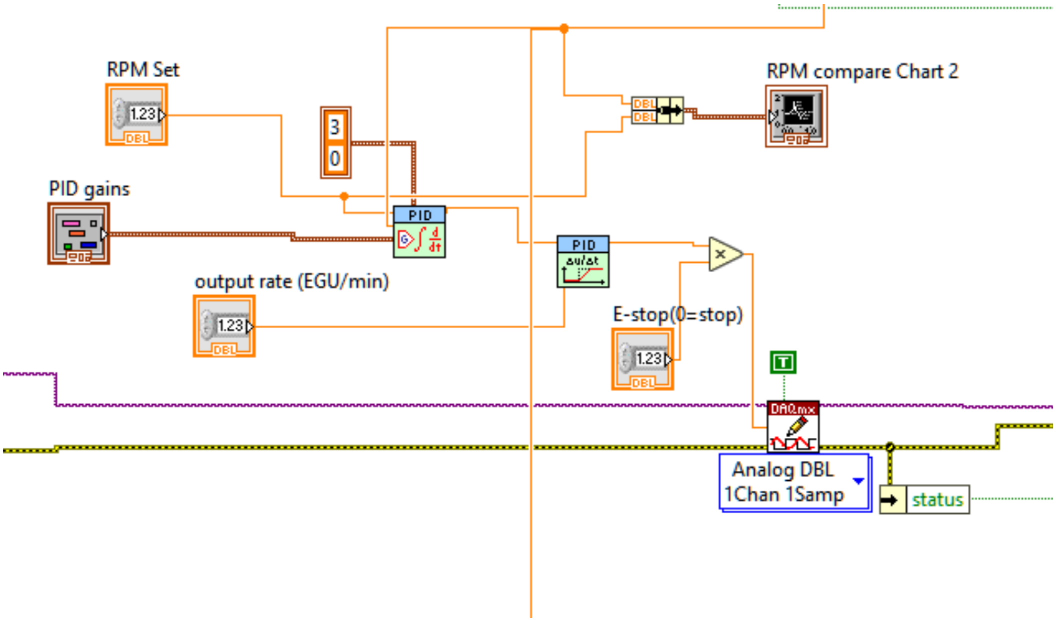
Custom Eddy Current Dynamometer Controller via Labview designed to calibrate new powertrain package. Design includes multiple modes of operation including constant torque, speed, and acceleration. A load cell is used to accurately measure torque off the engine. There is also additional support for high speed sensors such as in-cylinder pressure transducers.

Features:

- CAN data acquisition
- Multiple modes constant speed and torque
- High precision Load Cell
- Thermocouples support
- Additional Engine sensor support
- Support for high speed logging
- Fault monitoring



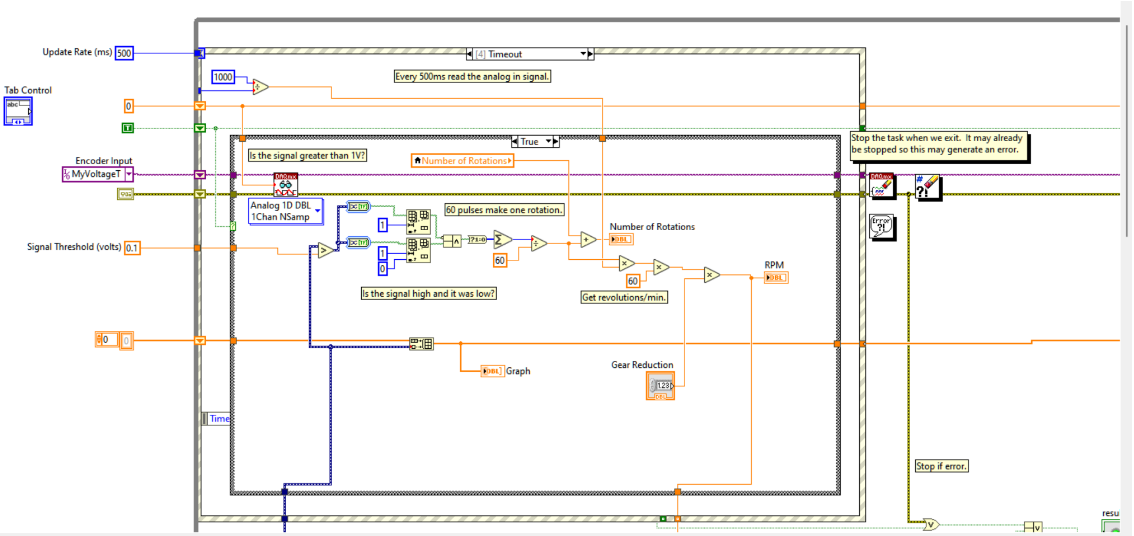
Constant Speed Controller



Operation:

Given a set RPM by the operator, this program uses a PID controller with a rate limited output to adjust the load created by the dyno until the actual RPM (derived from the RPM logic) matches the set RPM. A rate limiter is there to protect the powertrain from instantaneous load changes.

RPM Logic


Every 500ms read the analog in signal.

Is the signal greater than 1V?

60 pulses make one rotation.

Is the signal high and it was low?

Get revolutions/min.

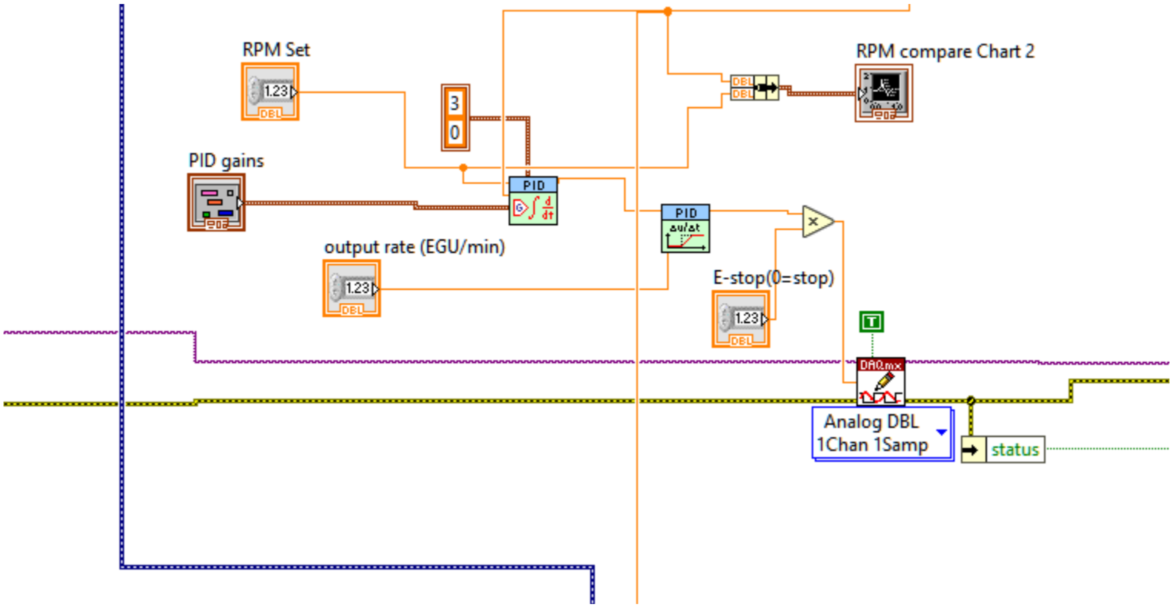
Stop the task when we exit. It may already be stopped so this may generate an error.

Stop if error.

Operation

The RPM logic is written to convert an analog signal from a hall effect sensor into speed. This code converts the sine wave into a digital signal. The digital signal is then used in a counter which is then used to convert into rotations.

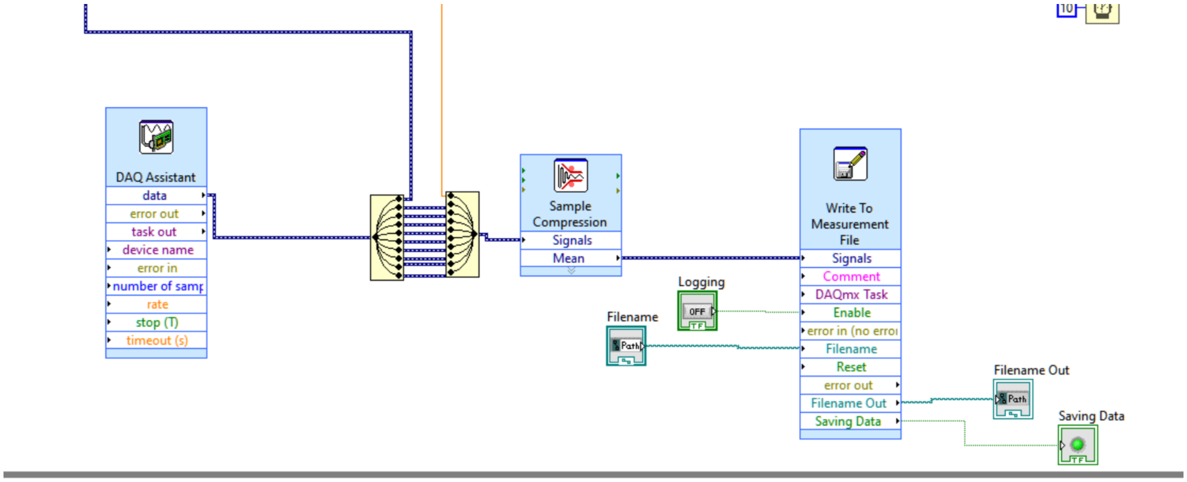
Speed/Load Controller



Operation

The speed controller on the Dyno is a simple PID controller with a rate limited output. The PID controls the output torque of the Dyno exerted on the engine in response to the speed derived from the RPM logic. The rate limiter is implemented as a safety precaution as instantaneous changes in load are not safe for the engine This controller can also be configured to be used as constant load that is determined by the operator.

Data Acquisition



Operation

The data acquisition of the dyno is all controlled by a NI-cDAQ. This allows for very high speed logging up to 100K Hz. High speed logging allows support of in-cylinder pressure transducers and O2. All low speed sensors are logged via CAN. This allows for ease of use as engine parameters and dyno data are all on the same CAN Bus.

ETC Switch Panel

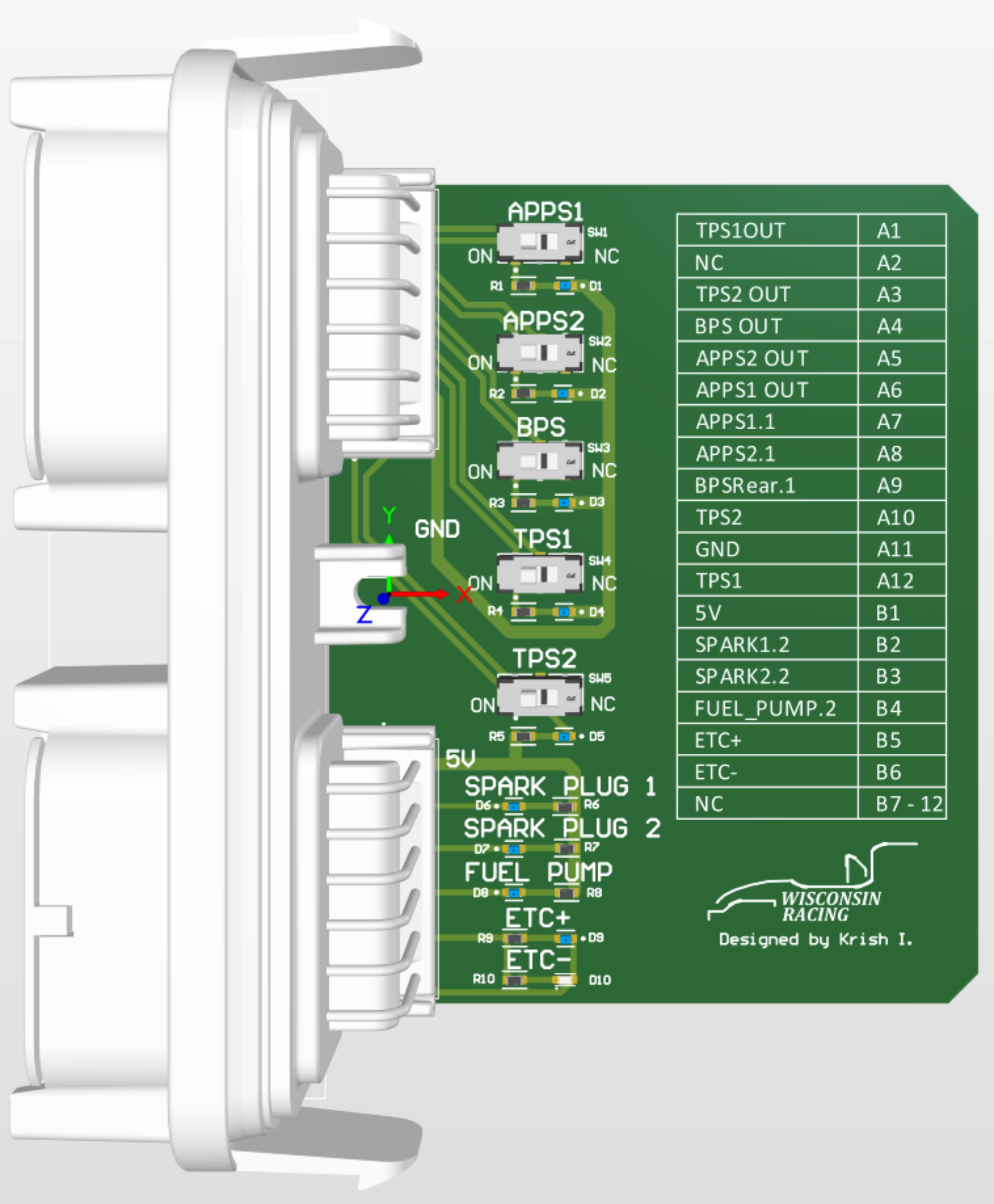
Engineer: Krish Isserdasani, Electrical Hardware Team Member
Revision: 2023.1
Dimensions: 65mm x 82mm

Overview

The purpose of this board is to verify the rules compliance of our electronic throttle controls. By adding an inline switch and LED, it allows a clear representation of signals or power being cut to show compliance with the Electronic Throttle Controls rules.

Features:

- Switches to connect and disconnect sensors
- LED indicators for power and signals
- 1 layer board and big traces to avoid suspicion



TPS1OUT	A1
NC	A2
TPS2 OUT	A3
BPS OUT	A4
APPS2 OUT	A5
APPS1 OUT	A6
APPS1.1	A7
APPS2.1	A8
BPSRear.1	A9
TPS2	A10
GND	A11
TPS1	A12
5V	B1
SPARK1.2	B2
SPARK2.2	B3
FUEL_PUMP.2	B4
ETC+	B5
ETC-	B6
NC	B7 - 12

Controls Systems Board

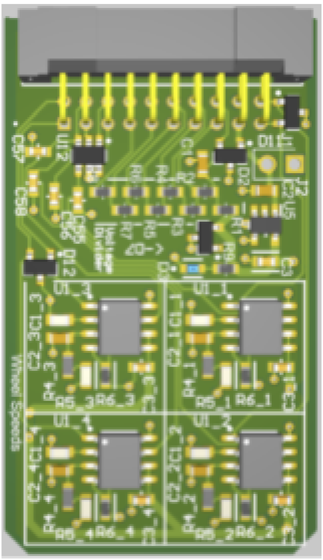
Engineers: Ishan Rai, Electrical Hardware Team Member and Tyler White, Electrical Hardware Team Member
Revision: 2023.1
Dimensions: 48.641mm x 28.321mm
Steady State Current Draw: 120mA

Overview

The controls systems board is one of several boards with the purpose of gathering information about the performance of the combustion car. This board integrates a gear position circuit and wheel speed conversion circuit onto one PCB. Wheel speed input to the board is a square wave from the sensor for each wheel's tone wheel, and the frequency of each square wave is converted to an analog output. The gear position side of the board has seven inputs but only one analog output to represent which input is currently grounded from the gear position sensor.

Features:

- Voltage divider for gear position that changes output voltage depending on which input is grounded
- Frequency to analog converters for each wheel speed, which use the TI LM2907 IC
- 12V to 5V linear regulator so that variance in input voltage doesn't change the analog output of either the voltage divider or frequency to analog converter
- Every input and output has TVS diodes and wheel speed outputs also have filtering capacitors

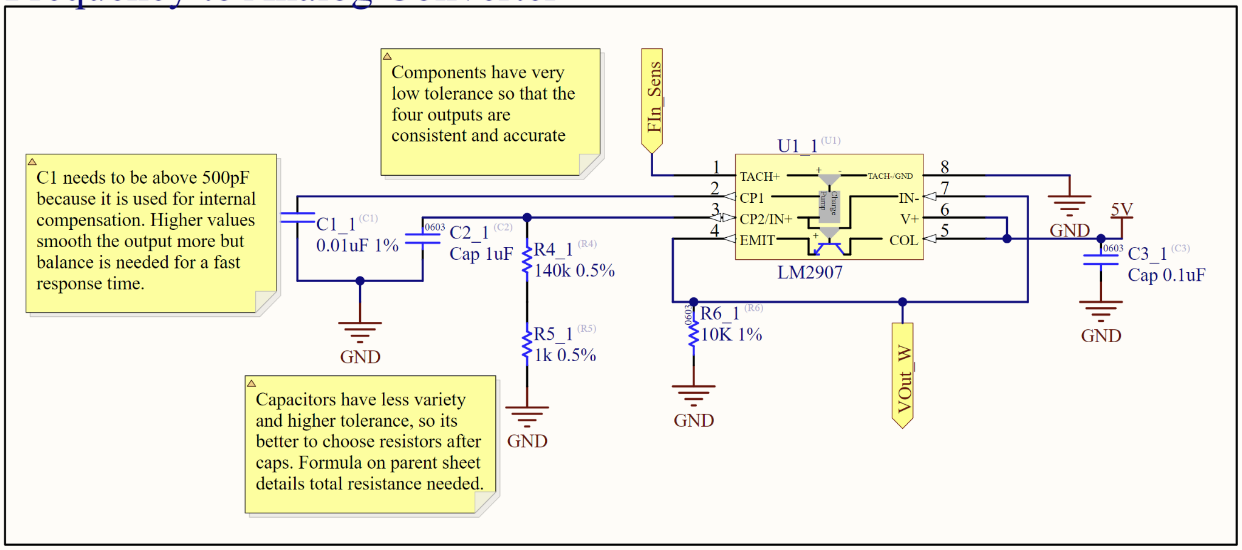


Controls Systems Board 3D Layout

Frequency to Analog Converter

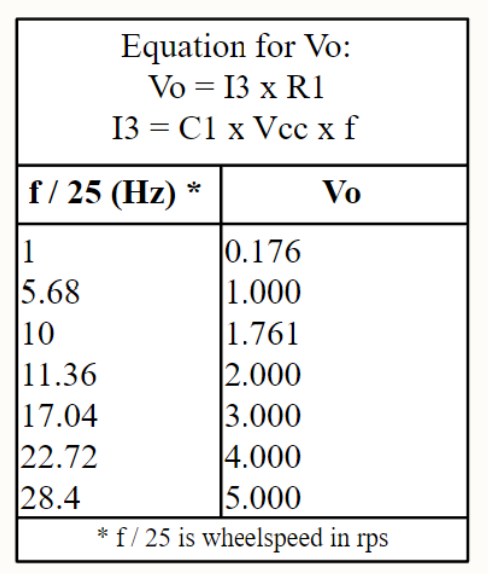
The frequency-to-analog converter makes use of the TI LM2907 IC, where the input frequency is first put through a comparator before entering the charge pump, which has one external capacitor so that the output resolution (Hz/V) can be tuned to a desired value. The voltage output by the charge pump is mirrored at the output of the IC via the op amp driving a BJT which altogether has negative feedback. The key equations for the operation of this system are $I3 = C1 \times Vcc \times f$ and $Vout = I3 \times R1$, where C1 is the external capacitor for the charge pump, I3 is current out of the charge pump, and R1 is the resistance to ground of the output of the charge pump, which for this specific board was broken into two resistors to achieve a more accurate resistance and precise outputs. To ensure each of the four ICs has the same output voltage for a frequency, components were chosen with small tolerances that also kept the response time high.

Frequency to Analog Converter


C1 needs to be above 500pF because it is used for internal compensation. Higher values smooth the output more but balance is needed for a fast response time.

Components have very low tolerance so that the four outputs are consistent and accurate

Capacitors have less variety and higher tolerance, so its better to choose resistors after caps. Formula on parent sheet details total resistance needed.


Equation for Vo:
Vo = I3 x R1
I3 = C1 x Vcc x f

f / 25 (Hz) *	Vo
1	0.176
5.68	1.000
10	1.761
11.36	2.000
17.04	3.000
22.72	4.000
28.4	5.000

* f / 25 is wheelspeed in rps

Gear Position Analog Converter

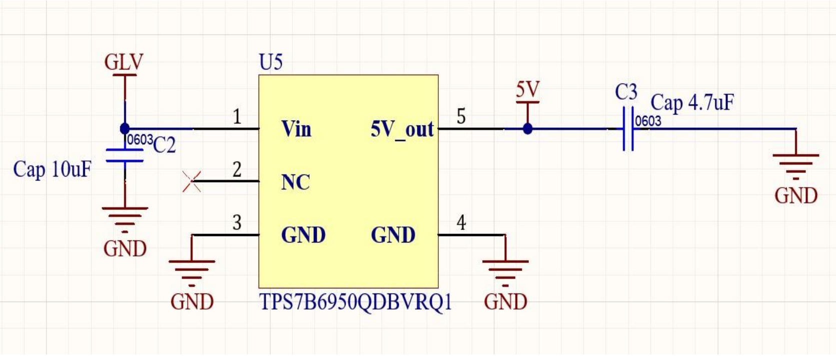
The gear position analog converter is responsible for converting the grounded input signals from the Gear Position sensors to an analog signal which is then fed into the ECU. This information is then relayed to the driver through displays on the steering wheel.

Operation

The converter uses an LDO to regulate voltage from 12V to 5V. When the car is in a certain gear position, the gear position sensor grounds the input corresponding to that gear. When this occurs, the resistance value in the voltage divider circuit changes, and a different output voltage is relayed for every gear position.

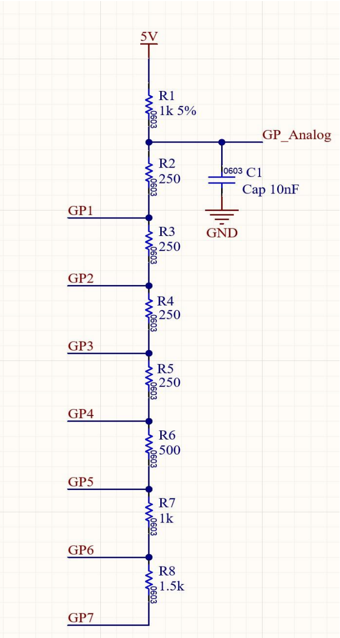
LDO Circuit

GLV is the Vin signal for the LDO. The LDO outputs a stable 5V signal which is then used as the input voltage for the voltage divider circuit. Capacitors C2 and C3 are decoupling capacitors and their values are based on manufacturer's recommendations given in the datasheet.



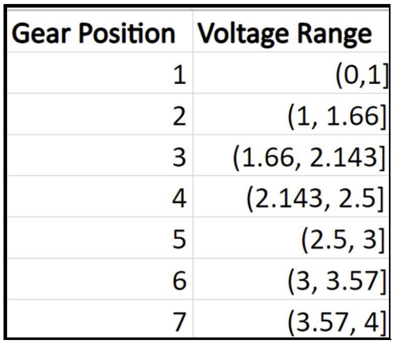
Voltage Divider Circuit

This is a typical voltage divider. GP1-GP7 are the gear position outputs and GP_Analog is the output signal. Capacitor C1 is a noise filtering capacitor. The value of the output voltage is determined using the following equation:



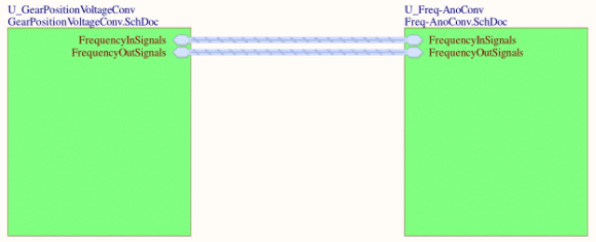
$$V_{out} = \frac{V_s \times R_2}{R_1+R_2}$$

Vs is the input voltage with a value of 5V. R2 varies based on the output of the gear position sensor and R1 is a fixed resistor with a value of 1k ohm.

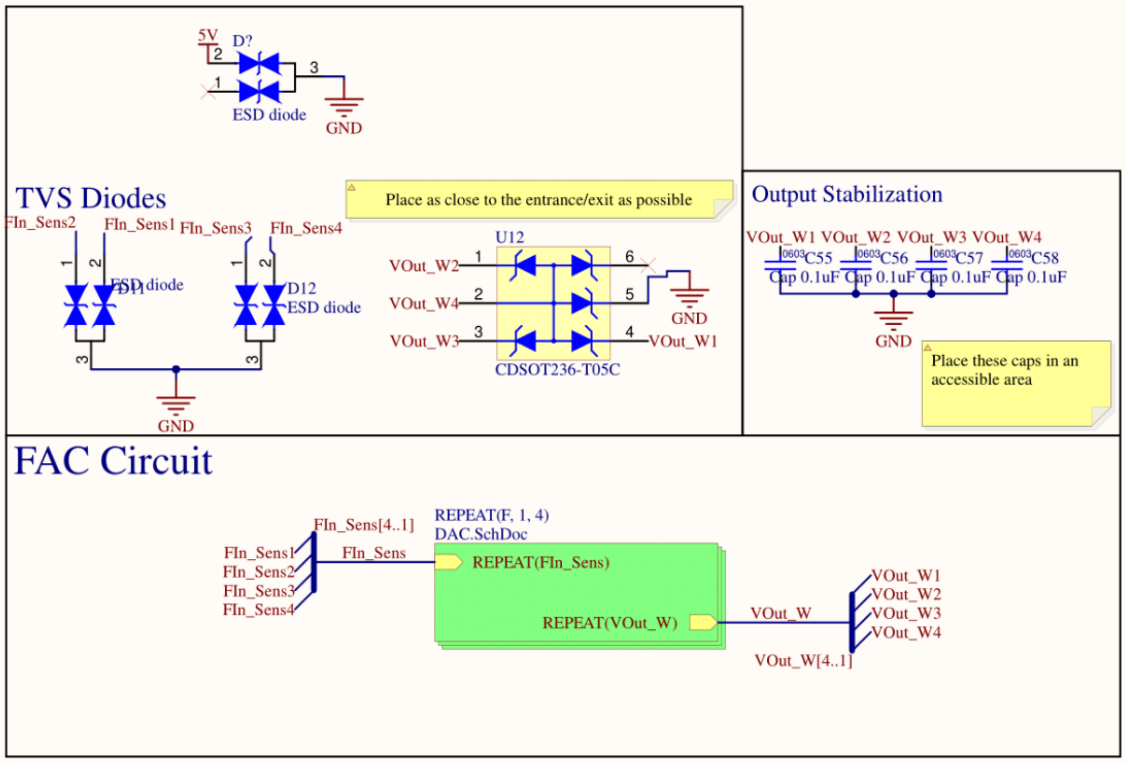


Gear Position	Voltage Range
1	(0,1]
2	(1, 1.66]
3	(1.66, 2.143]
4	(2.143, 2.5]
5	(2.5, 3]
6	(3, 3.57]
7	(3.57, 4]

Output voltage range of every gear position has been provided in this table.



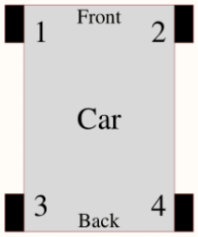
Title
TopLevel
Designer
Ishan & Tyler
Revision
*
Date: 5/15/2023
File: TopLevel.SchDoc

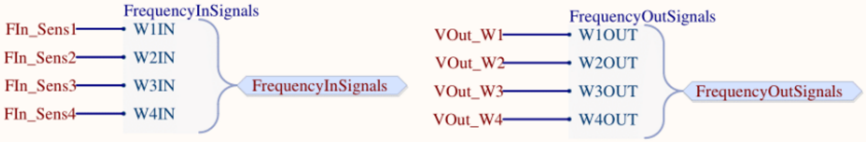


Equation for Vo:
Vo = I3 x R1
I3 = C1 x Vcc x f

f / 25 (Hz) *	Vo
1	0.176
5.68	1.000
10	1.761
11.36	2.000
17.04	3.000
22.72	4.000
28.4	5.000

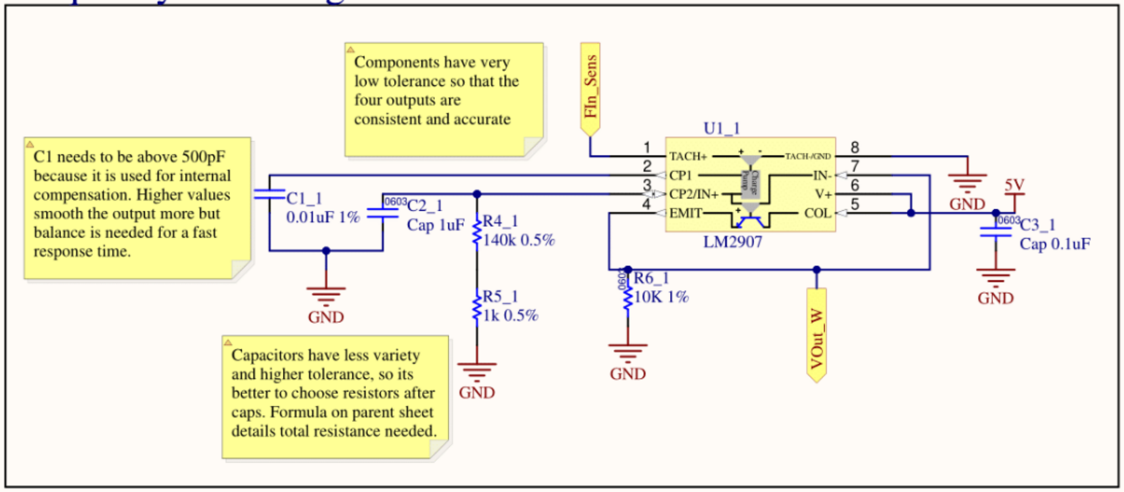
* f / 25 is wheelspeed in rps





Title **Frequency to Analog Converter**	
Designer **Tyler White**	Revision **223.3**
Date: 5/15/2023	
File: Freq-AnoConv.SchDoc	

Frequency to Analog Converter



C1 needs to be above 500pF because it is used for internal compensation. Higher values smooth the output more but balance is needed for a fast response time.

Components have very low tolerance so that the four outputs are consistent and accurate

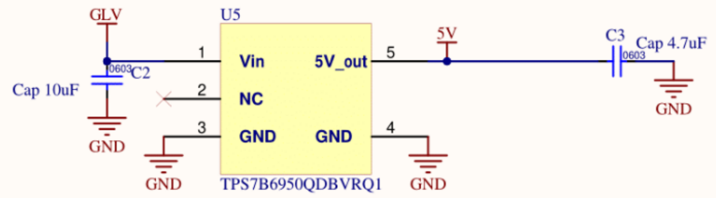
Capacitors have less variety and higher tolerance, so its better to choose resistors after caps. Formula on parent sheet details total resistance needed.

Title
Wheelspeed DAC

Designer	Revision
Tyler White	**223.3**

Date: 5/15/2023
File: DAC.SchDoc

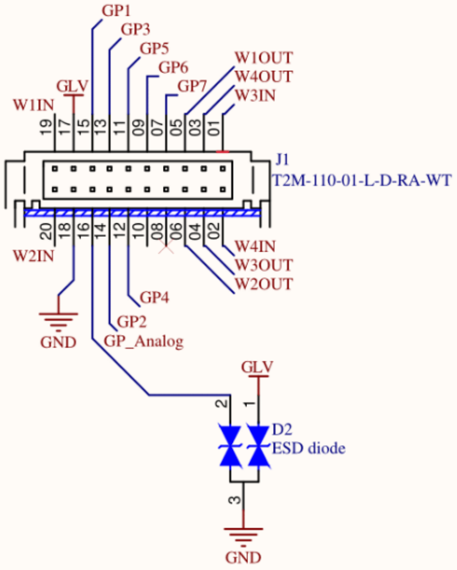
LDO



U5 has an output current of 150mA

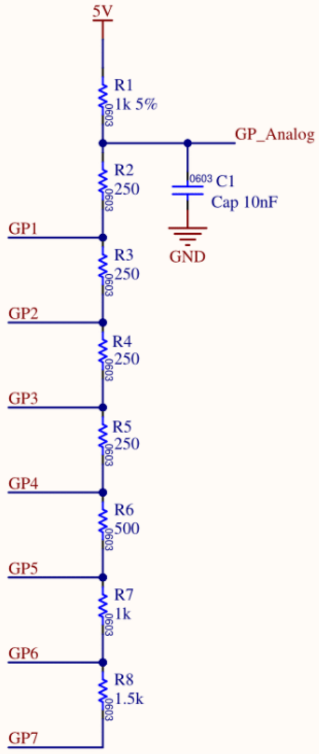
C2 and **C3** are decoupling capacitors with values recommended by the datasheet

Connector



Voltage Divider for analog output

C1 is a noise filtering capacitor



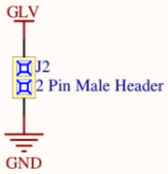
When gear is not in position, GPx (x is 1-7) is floating. When it is in position, it is grounded.

Voltage range and formula used

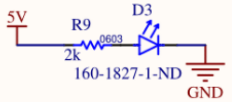
Cannot open file C:\Users\ishan\Downloads\Screenshot 2023-01-25 101310.png. File does not exist.

Cannot open file C:\Users\ishan\Downloads\Screenshot 2023-01-25 102623.png. File does not exist.

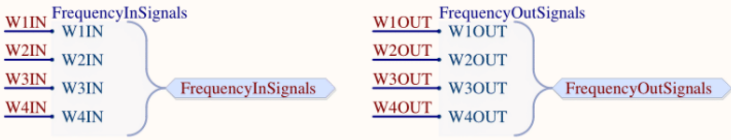
Header for power and ground



Indicator LED



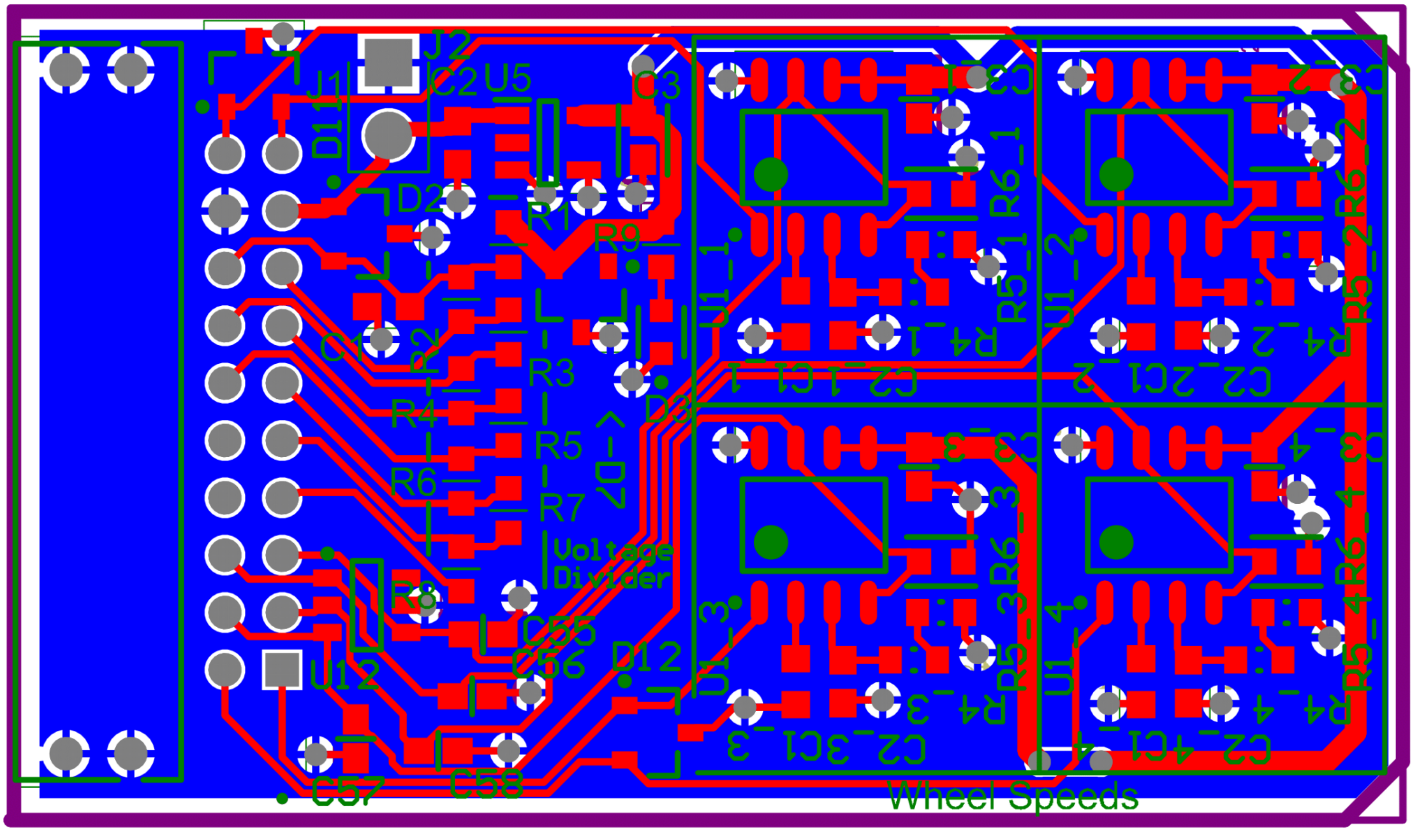
Freq Input and Voltage Output harness



Title
Gear Position Voltage Converter
Designer **Ishan Rai**
Revision **223.1**
Date: 5/15/2023
File: GearPositionVoltageConv.SchDoc

WISCONSIN FORMULA SAE Racing

PCB Printout



Tire Temp Sensor

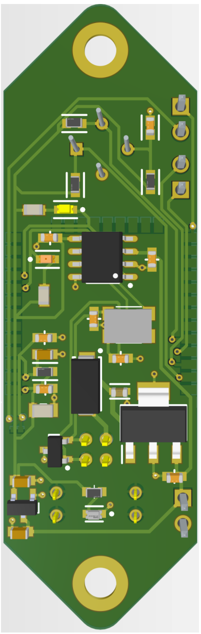
Engineer: Joshua Cobian
Revision: 2023.2
Dimensions: 64mm x 23mm
Steady State Current Draw: 115mA

Overview

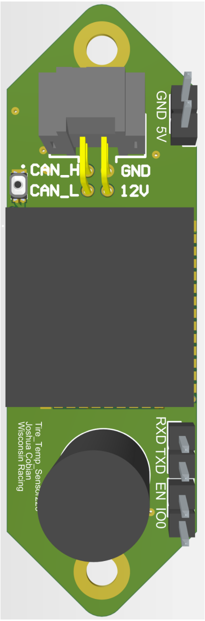
The Tire Temperature Sensor board is a programmable circuit board that will take the real time temperatures of the tires. The board uses an ESP32-WROOM microprocessor to read data from an IR sensor and sends that data over CAN to the steering wheel, vehicle controller, and the data logger. The circuit board is split between top and bottom. The top is where the microprocessor, IR sensor and all the headers needed to run or flash the board live. The bottom is where the power delivery, CAN, and other supportive circuitry for the IR sensor and microprocessor are. Other than read temperatures, the main goal of the board is to prove that the ESP32-WROOM could be used as a main microprocessor for a board that communicates with CAN.

Features:

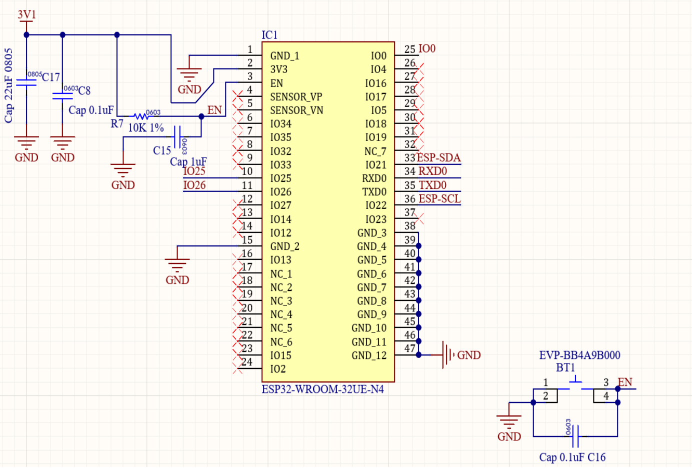
- Uses a programmable ESP32-WROOM
- Uses a matrix based IR sensor
- Is powered by 12V but can also be powered by 5V for flashing code
- Communicates over CAN
- Small enough to fit in an enclosure
- Rate for high temperatures and shaking
- Expected current draw is 120mA - 140mA



Bottom of Board 3D



Top of Board 3D



ESP32-Wroom

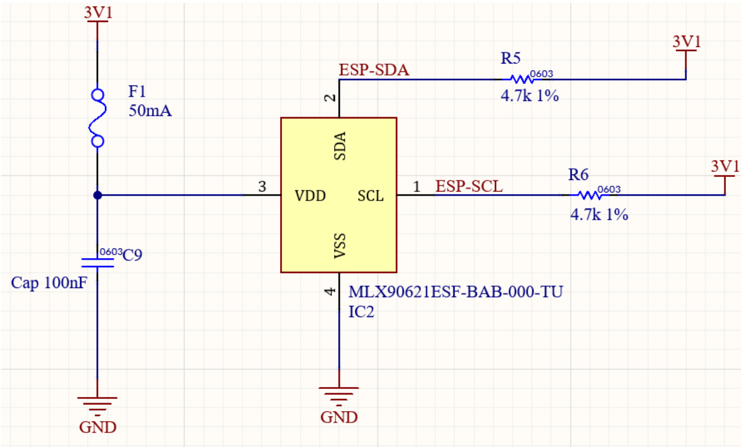
Microprocessor

The ESP32-Wroom is the main processor for this board. It will read data from the IR sensor through I2C and transmit it to the CAN circuitry through CANRXD and CANTXD. The ESP32-WROOM was chosen because it would work with CAN, the team had a reliable way to flash it with code, it worked with Arduino, and it was relatively inexpensive. The

Custom circuit around it is taken directly from the ESP32-WROOM's datasheet. It recommends a RC circuit on enable for startup and also filtering capacitors for the power input.

IR Sensor

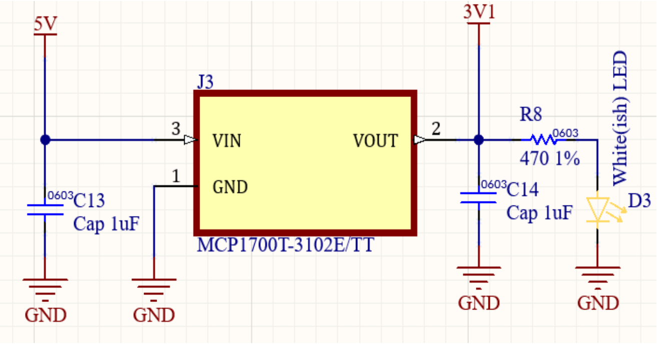
The IR sensor collects temperature data from the wheel and sends it to the microprocessor using I2C. The specific model is MLX90621ESF-BAB-000-TU. It was decided to use this model because it was in use by the earlier iteration of the temperature sensor board, and the sensors were quite expensive. Also because it was expensive a 50ma fuse was added to protect the sensor.



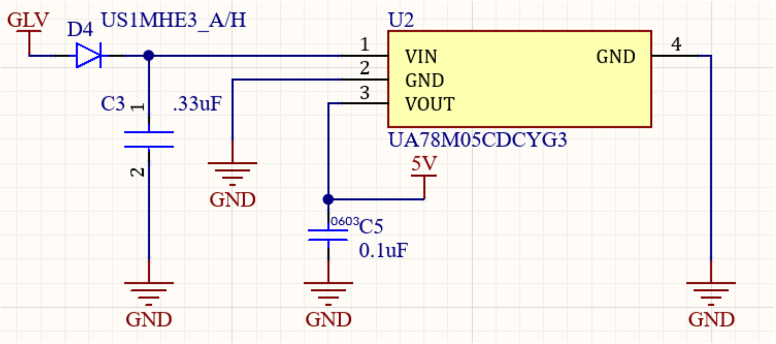
IR Sensor

Power Delivery

The board is powered by 12V from the Low Voltage Battery and requires a 5V for the CAN transceiver and 3.3V for the microprocessor and 2.7V for the IR sensor. In order to compromise and to make the circuitry small enough, it was decided to run the ESP32-WROOM and IR sensor at 3.1V which is within the operational range of both. For both voltage drops a linear dropout regulator (LDO) was used. The 12V to 5V LDO is significantly bigger than the 5V to 3.1V LDO because there is expected to be more heat due to the larger amount of voltage dropped. In order to make the board capable of being powered by a 5V input, a rectifier diode was added to the 12V to 5V LDO. A LED was also added to the 5V to 3.1V LDO so it is known when the board is powered.



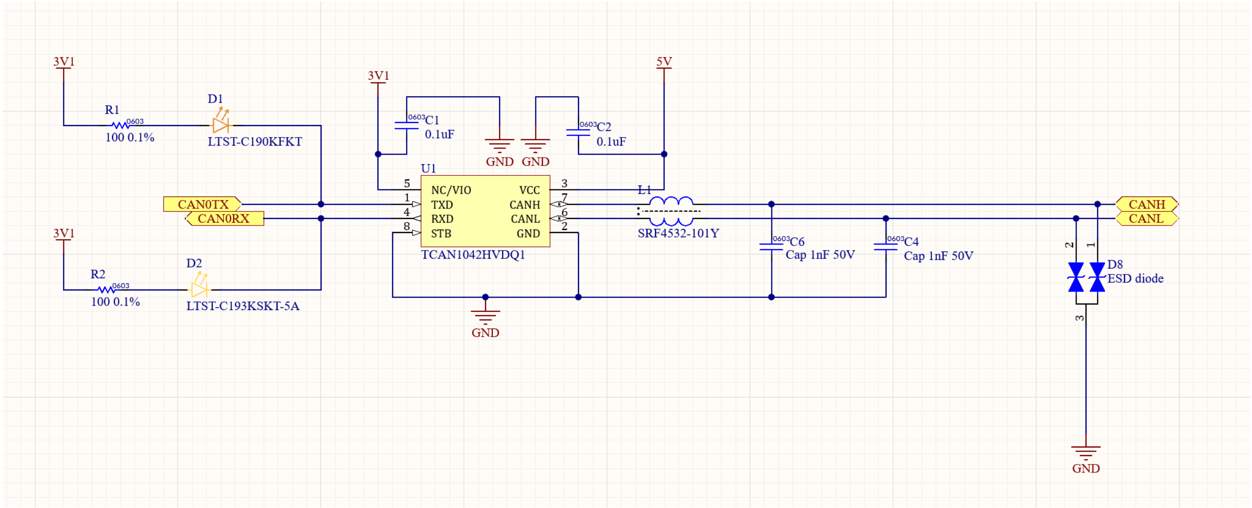
5V to 3.1V LDO



12V to 5V LDO

CAN

The team uses the TCAN family of CAN transceivers with integrated level shifters. The CAN circuit is used across both cars and features LEDs to show when CAN communication is occurring, a common mode choke for noise rejection and ESD diodes. This circuit is common on all PCBs that use CAN on the car.



TCAN

Code

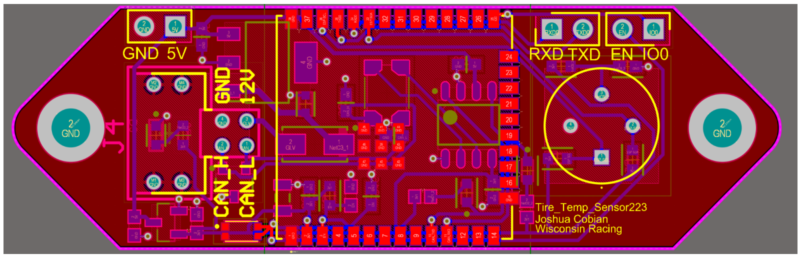
The code the microprocessor uses is written in Arduino. It takes in the data from the IR sensor which is a 4x16 temperature data matrix and compresses it into a 1x8 temperature data matrix by averaging down the four rows to one row. It then sends this smaller package over can to the various places in the car that needs it. The team flashes the ESP32-WROOM with code using a by hooking up the TXD, RXD, IO0, and EN broken out pins to a ESP-32-WROVER devkit.

Layout Notes

The layout of this board is split between top and bottom. The top is where the microprocessor, IR sensor and all the headers needed to run or flash the board live. The bottom is where the power delivery, CAN, and other supportive circuitry for the IR sensor and microprocessor are. The board dimensions are 62.5997mm X 19.5mm

Top

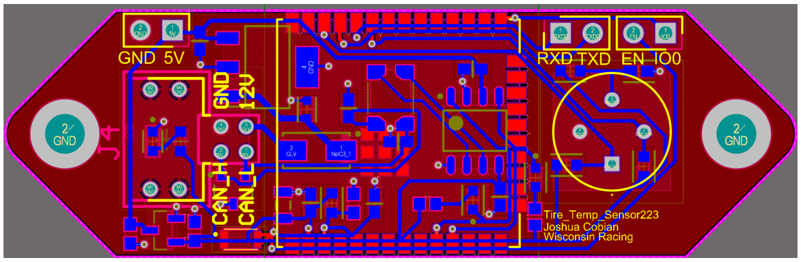
The centerpiece of this board is the microprocessor and it is in the middle of the top. It was put there because it required the most space underneath it to put the surrounding circuitry and traces that were required to make it operate correctly. The other components are placed in such a way to get the maximum space underneath the board. The large round holes on the sides of the board are for mounting near the wheel in an enclosure. The top layer is a nearly fully continuous ground plane except for the ESP32 microprocessor.



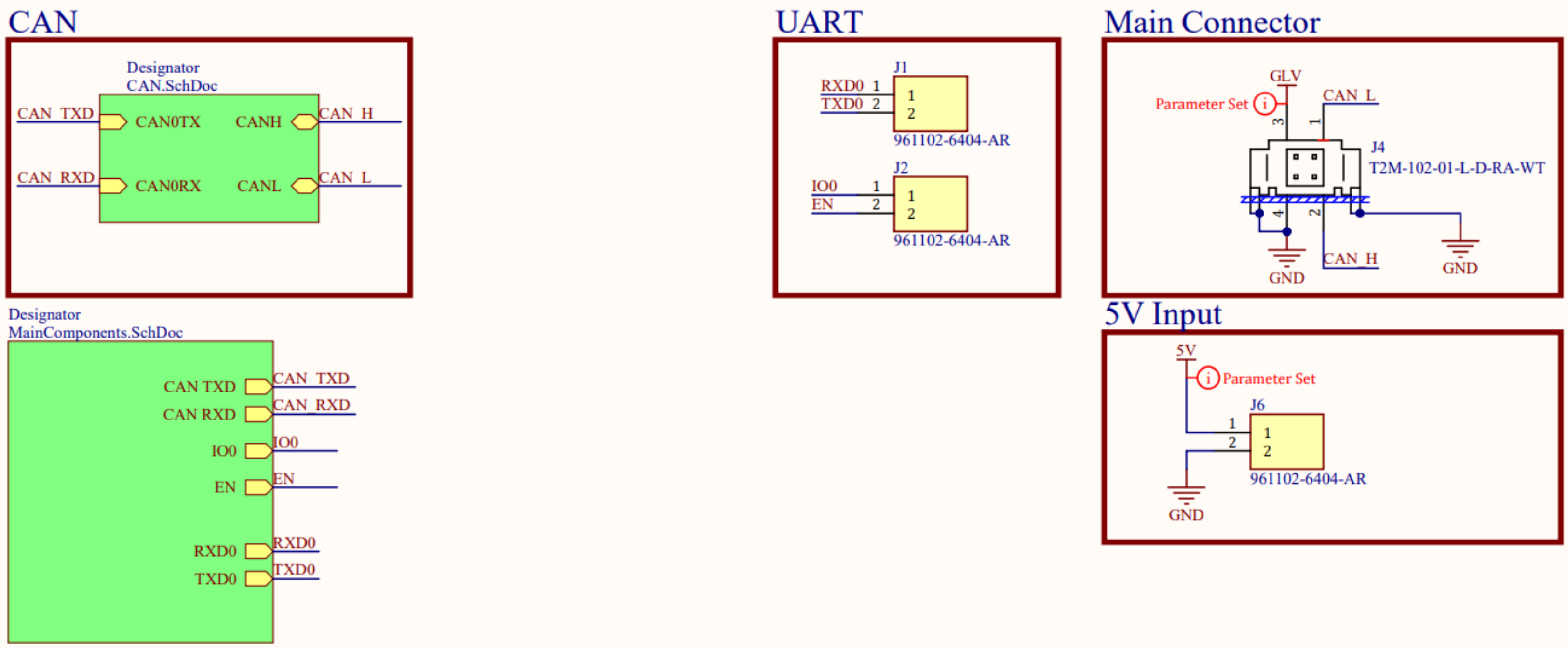
Top of Board 2D

Bottom

The bottom is laid out as follows from left to right. Power delivery, microprocessor, TCAN, and IR Sensor. This was done so that the components on the bottom are arranged to support the components on the top as close as they can be to ensure signal integrity.



Bottom of Board 2D

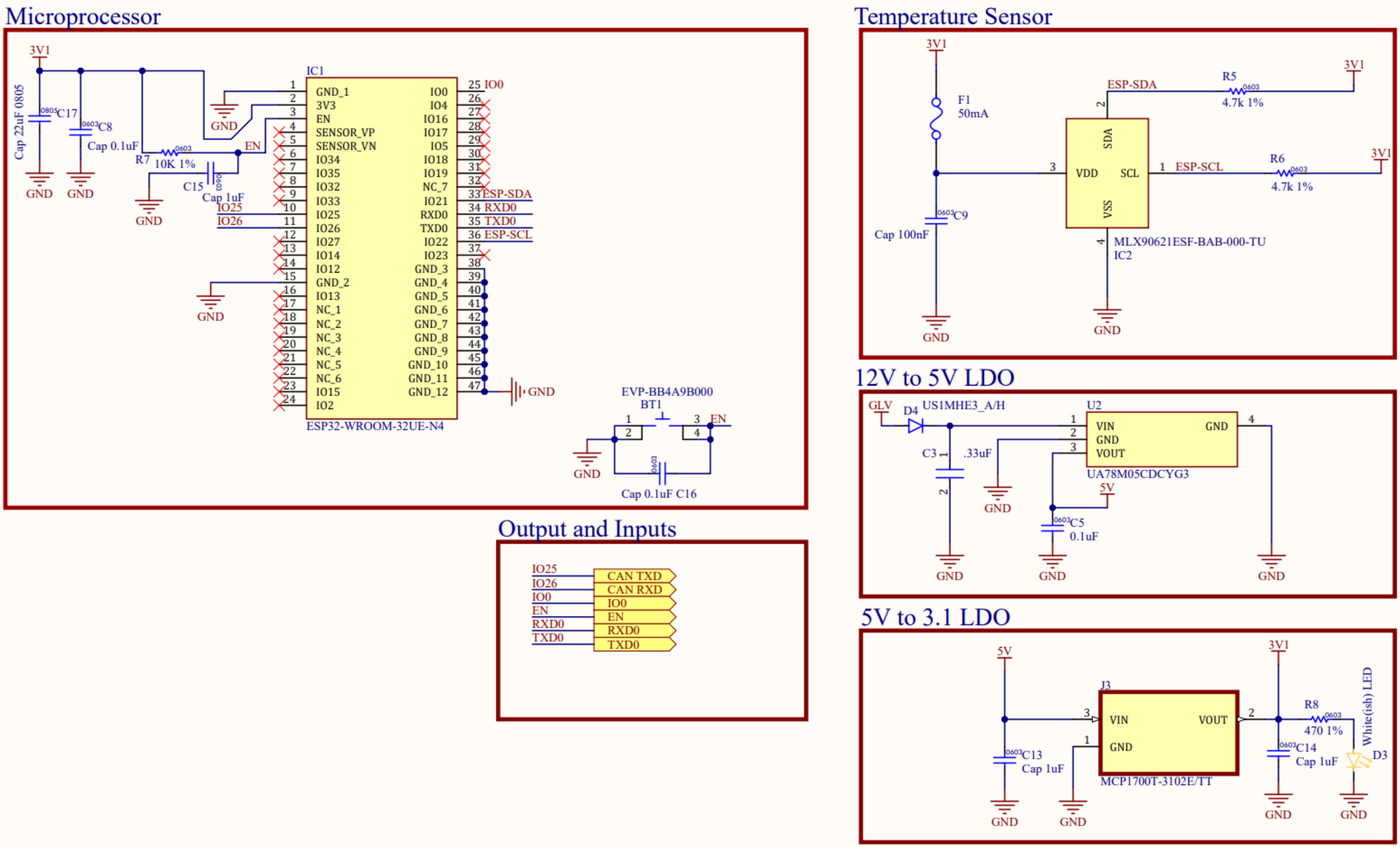


Title
Tire Temp Sensor

Designer
Joshua Cobian

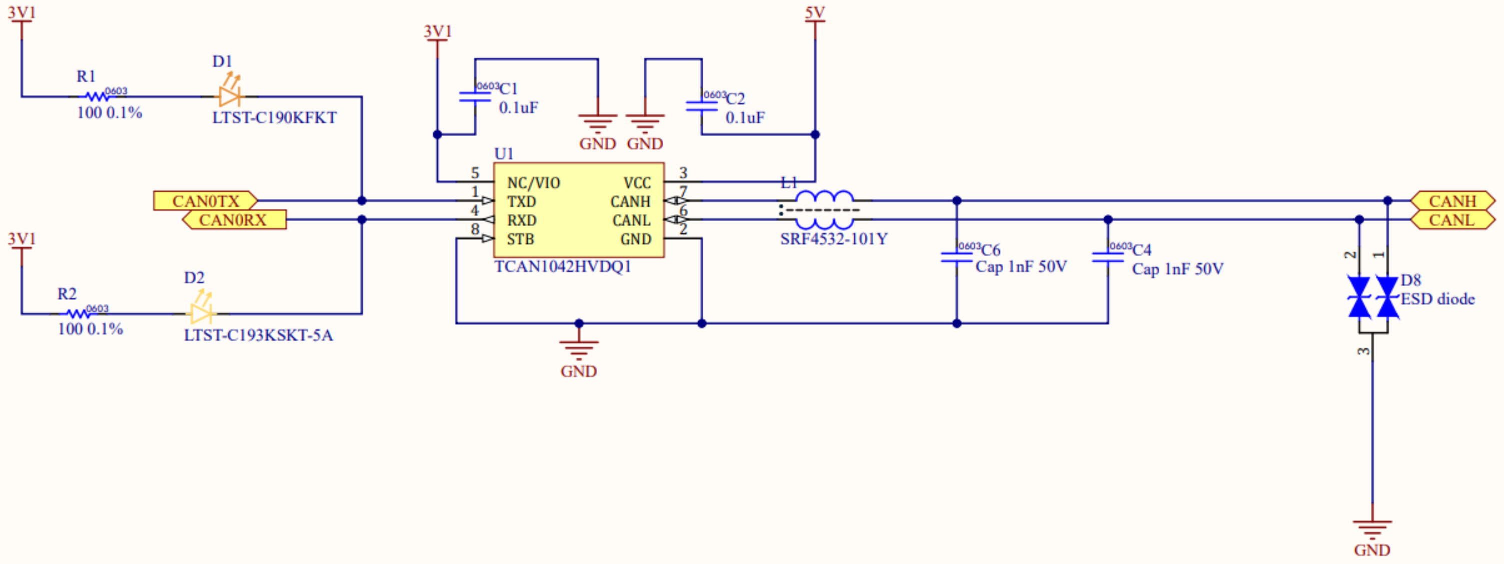
Revision
223.1

Date: 5/14/2023
File: TireTempSensor.SchDoc



Title	
Tire_Temp_223	
Designer	Revision
Joshua Cobian	*223.1*

Date: 5/14/2023
File: MainComponents.SchDoc



Title
CAN

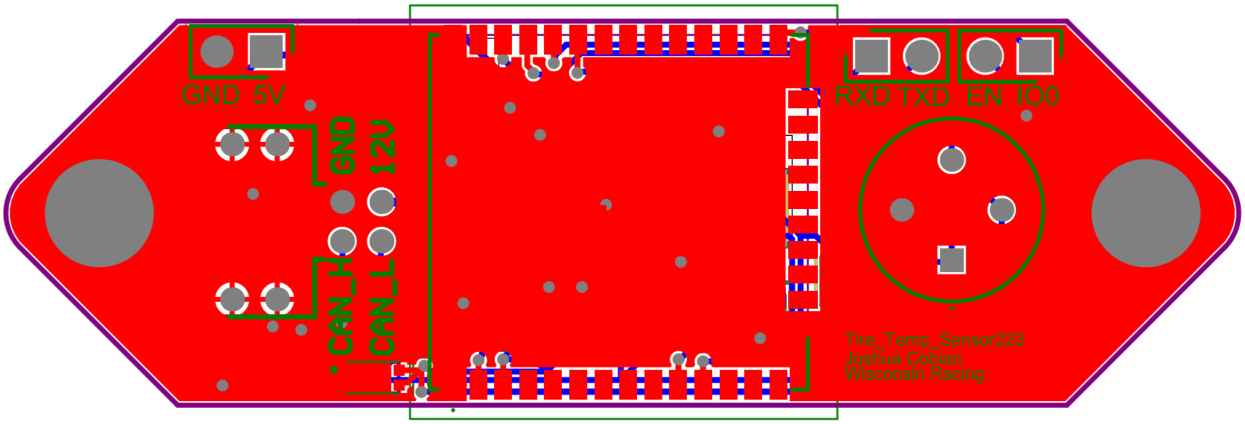
Designer
Joshua Cobian

Revision
223.1

Date: 5/14/2023
File: CAN.SchDoc

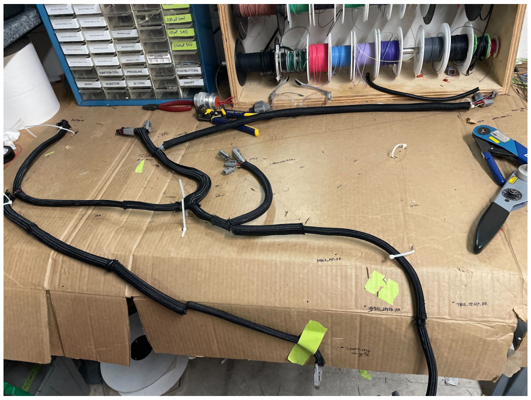
WISCONSIN FORMULA SAE Racing

PCB Printout



Systems Integration

Engineers: Calvin Geishirt, LV Electronics Lead,
Shrey Patel, Controls Lead,
Surya Raghavendran, Controls Lead,
Krish Isserdasani, Electrical Hardware Team Member, and
Shreya Mukherjee, Electrical Hardware Team Member



Harnessing

Wiring harness design and manufacturing is a cross sub-team effort between the electrical hardware team and the controls team. The team starts by adding every sensor, PCB, ECU, and switch to a centralized excel spreadsheet. Components are then added to a RapidHarness schematic, and signals are connected. Lengths can then be added between nodes, and a wiring table is generated for manufacturing. The team then manufactures the entire harness in house.

Features:

- Harness is split into 3 sections for ease of manufacturing and maintenance
- Field serviceable Deutsch DTM connectors used as much as possible
- RapidHarness schematics greatly aid in manufacturing process

Front Harness

The front harness contains everything in front of the driver. This includes dash buttons, APPS potentiometers, brake pressure sensors, the steering wheel, and more. The front harness connects to the central harness with a “bulkhead” connector, a high pin density Deutsch Autosport connector.

Central Harness

The central harness contains the ECU, which is where almost all signals must go. Bulkheads from the front and rear connect here. Our data logger, the EVO5, also connects to this portion of the harness.

Rear Harness

The rear harness runs by the engine, and all engine sensors need to be connected to this harness. This is by far the most complicated part of the harness. The rear harness needs two bulkheads to pass all the signals, both from the Deutsch series. Both use the same pins that we use for the Deutsch DTM and DT series connectors, making them easily serviceable.

Dyno Harness

The dyno harness is a special made harness that only contains the connectors for sensors we would need on the dyno. The harness was split into two sections, one part connects to the engine, and the other half connects to the ECU and control room switches.

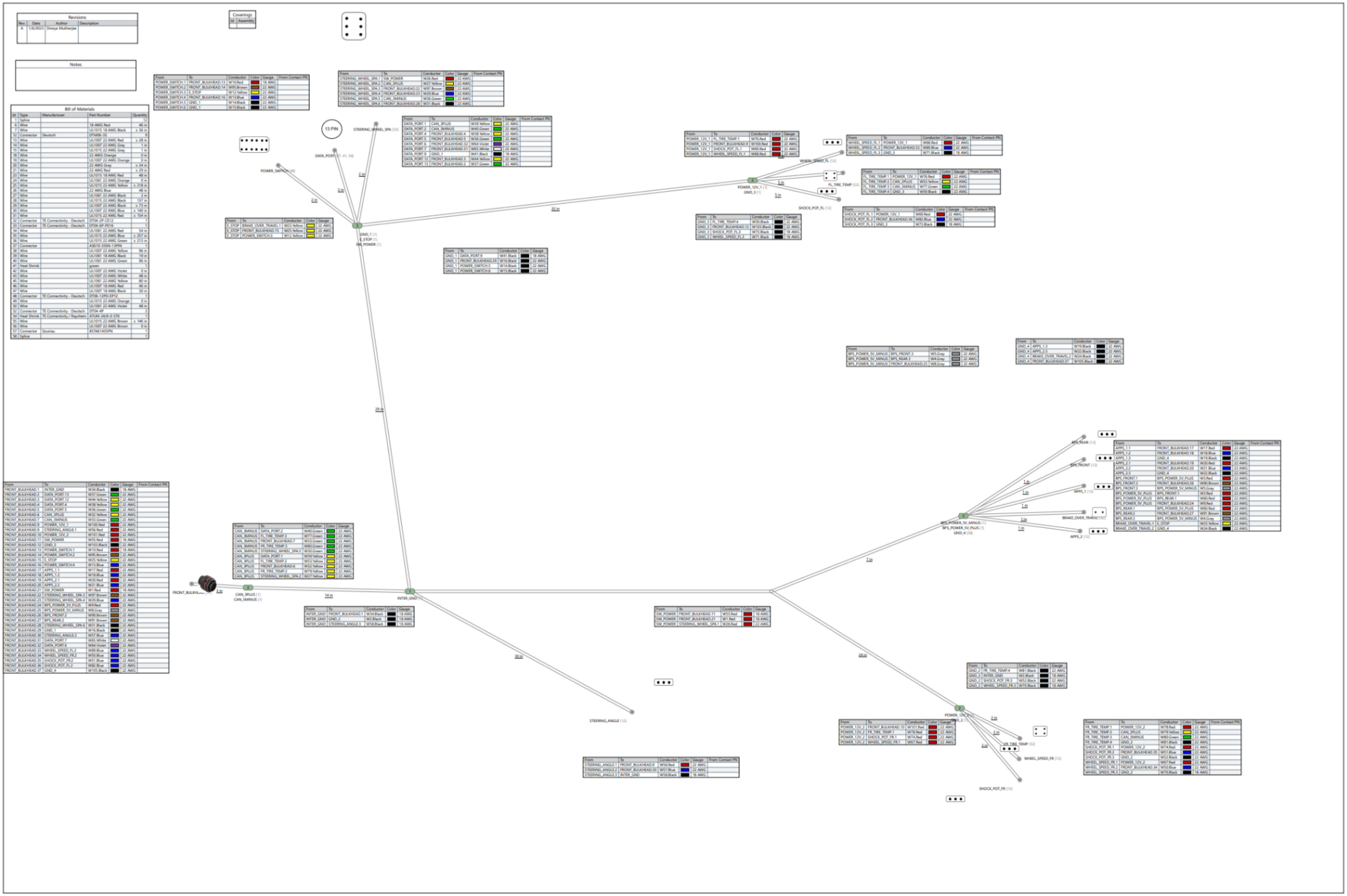
Revisions			
Rev.	Date	Author	Description
A	1/6/2023	Shreya Mukherjee	

Coverings	
Id	Assembly

Notes

Bill of Materials

Id	Type	Manufacturer	Part Number	Quantity
1	Splice			12
6	Wire		18 AWG Red	46 in
7	Wire		UL1015 18 AWG Black	≥ 36 in
12	Connector	Deutsch	DTM06-3S	9
13	Wire		UL1007 22 AWG Red	≥ 28 in
14	Wire		UL1007 22 AWG Gray	1 in
15	Wire		UL1015 22 AWG Gray	1 in
18	Wire		22 AWG Orange	0 in
19	Wire		UL1007 22 AWG Orange	0 in
20	Wire		22 AWG Gray	≥ 24 in
21	Wire		22 AWG Red	≥ 29 in
23	Wire		UL1015 18 AWG Red	48 in
24	Wire		UL1061 22 AWG Orange	0 in
25	Wire		UL1015 22 AWG Yellow	≥ 218 in
26	Wire		22 AWG Blue	48 in
27	Wire		UL1061 22 AWG Black	2 in
28	Wire		UL1015 22 AWG Black	137 in
29	Wire		UL1007 22 AWG Black	≥ 73 in
30	Wire		UL1007 22 AWG Blue	≥ 140 in
31	Wire		UL1015 22 AWG Red	≥ 154 in
32	Connector	TE Connectivity - Deutsch	DT04-2P-CE12	1
33	Connector	TE Connectivity - Deutsch	DT04-6P-P016	1
34	Wire		UL1061 22 AWG Red	54 in
35	Wire		UL1015 22 AWG Blue	≥ 257 in
36	Wire		UL1015 22 AWG Green	≥ 213 in
37	Connector		AS010-35SN-13PIN	1
38	Wire		UL1007 22 AWG Yellow	96 in
39	Wire		UL1061 18 AWG Black	19 in
40	Wire		UL1061 22 AWG Green	96 in
41	Heat Shrink		green	1
42	Wire		UL1007 22 AWG Violet	0 in
43	Wire		UL1007 22 AWG White	48 in
45	Wire		UL1061 22 AWG Yellow	80 in
46	Wire		UL1007 18 AWG Red	46 in
47	Wire		UL1007 18 AWG Black	30 in
48	Connector	TE Connectivity - Deutsch	DT06-12PD-EP12	1
49	Wire		UL1015 22 AWG Orange	0 in
50	Wire		UL1061 22 AWG Violet	48 in
52	Connector	TE Connectivity - Deutsch	DT04-4P	2
54	Heat Shrink	TE Connectivity / Raychem	ATUM-24/6-0-STK	1
55	Wire		UL1015 22 AWG Brown	≥ 146 in
56	Wire		UL1007 22 AWG Brown	0 in
57	Connector	Souriau	8STA61435PN	1
58	Splice			1



From	To	Conductor	Color	Gauge	From Contact PN
POWER_SWITCH.1	FRONT_BULKHEAD.13	W10.Red	🟥	18 AWG	
POWER_SWITCH.2	FRONT_BULKHEAD.14	W95.Brown	🟫	22 AWG	
POWER_SWITCH.3	E_STOP	W12.Yellow	🟨	22 AWG	
POWER_SWITCH.4	FRONT_BULKHEAD.16	W13.Blue	🟦	22 AWG	
POWER_SWITCH.5	GND_1	W14.Black	⬛	22 AWG	
POWER_SWITCH.6	GND_1	W15.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
STEERING_WHEEL_SPA.1	SW_POWER	W26.Red	🟥	22 AWG	
STEERING_WHEEL_SPA.2	CAN_3PLUS	W27.Yellow	🟨	22 AWG	
STEERING_WHEEL_SPA.3	FRONT_BULKHEAD.22	W97.Brown	🟫	22 AWG	
STEERING_WHEEL_SPA.4	FRONT_BULKHEAD.23	W29.Blue	🟦	22 AWG	
STEERING_WHEEL_SPA.5	CAN_3MINUS	W30.Green	🟩	22 AWG	
STEERING_WHEEL_SPA.6	FRONT_BULKHEAD.28	W31.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
DATA_PORT.1	CAN_3PLUS	W39.Yellow	🟨	22 AWG	
DATA_PORT.2	CAN_3MINUS	W40.Green	🟩	22 AWG	
DATA_PORT.4	FRONT_BULKHEAD.4	W38.Yellow	🟨	22 AWG	
DATA_PORT.5	FRONT_BULKHEAD.5	W36.Green	🟩	22 AWG	
DATA_PORT.6	FRONT_BULKHEAD.32	W64.Violet	🟪	22 AWG	
DATA_PORT.7	FRONT_BULKHEAD.31	W65.White	⬜	22 AWG	
DATA_PORT.9	GND_1	W41.Black	⬛	18 AWG	
DATA_PORT.12	FRONT_BULKHEAD.3	W44.Yellow	🟨	22 AWG	
DATA_PORT.13	FRONT_BULKHEAD.2	W37.Green	🟩	22 AWG	

From	To	Conductor	Color	Gauge
E_STOP	BRAKE_OVER_TRAVEL.1	W23.Yellow	🟨	22 AWG
E_STOP	FRONT_BULKHEAD.15	W25.Yellow	🟨	22 AWG
E_STOP	POWER_SWITCH.3	W12.Yellow	🟨	22 AWG

From	To	Conductor	Color	Gauge
GND_1	DATA_PORT.9	W41.Black	⬛	18 AWG
GND_1	FRONT_BULKHEAD.29	W16.Black	⬛	22 AWG
GND_1	POWER_SWITCH.5	W14.Black	⬛	22 AWG
GND_1	POWER_SWITCH.6	W15.Black	⬛	22 AWG

From	To	Conductor	Color	Gauge
POWER_12V_1	FL_TIRE_TEMP.1	W76.Red	🟥	22 AWG
POWER_12V_1	FRONT_BULKHEAD.9	W100.Red	🟥	22 AWG
POWER_12V_1	SHOCK_POT_FL.1	W69.Red	🟥	22 AWG
POWER_12V_1	WHEEL_SPEED_FL.1	W68.Red	🟥	22 AWG

From	To	Conductor	Color	Gauge	From Contact PN
WHEEL_SPEED_FL.1	POWER_12V_1	W68.Red	🟥	22 AWG	
WHEEL_SPEED_FL.2	FRONT_BULKHEAD.33	W89.Blue	🟦	22 AWG	
WHEEL_SPEED_FL.3	GND_3	W71.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
FL_TIRE_TEMP.1	POWER_12V_1	W76.Red	🟥	22 AWG	
FL_TIRE_TEMP.2	CAN_3PLUS	W53.Yellow	🟨	22 AWG	
FL_TIRE_TEMP.3	CAN_3MINUS	W77.Green	🟩	22 AWG	
FL_TIRE_TEMP.4	GND_3	W59.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge
GND_3	FL_TIRE_TEMP.4	W59.Black	⬛	22 AWG
GND_3	FRONT_BULKHEAD.12	W103.Black	⬛	22 AWG
GND_3	SHOCK_POT_FL.3	W73.Black	⬛	18 AWG
GND_3	WHEEL_SPEED_FL.3	W71.Black	⬛	18 AWG

From	To	Conductor	Color	Gauge	From Contact PN
SHOCK_POT_FL.1	POWER_12V_1	W69.Red	🟥	22 AWG	
SHOCK_POT_FL.2	FRONT_BULKHEAD.36	W82.Blue	🟦	22 AWG	
SHOCK_POT_FL.3	GND_3	W73.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge
BPS_POWER_5V_MINUS	BPS_FRONT.3	W5.Gray	▨	22 AWG
BPS_POWER_5V_MINUS	BPS_REAR.3	W4.Gray	▨	22 AWG
BPS_POWER_5V_MINUS	FRONT_BULKHEAD.25	W8.Gray	▨	22 AWG

From	To	Conductor	Color	Gauge
GND_4	APPS_1.3	W19.Black	⬛	22 AWG
GND_4	APPS_2.3	W22.Black	⬛	22 AWG
GND_4	BRAKE_OVER_TRAVEL.2	W24.Black	⬛	22 AWG
GND_4	FRONT_BULKHEAD.37	W105.Black	⬛	22 AWG

From	To	Conductor	Color	Gauge	From Contact PN
APPS_1.1	FRONT_BULKHEAD.17	W17.Red	🟥	22 AWG	
APPS_1.2	FRONT_BULKHEAD.18	W18.Blue	🟦	22 AWG	
APPS_1.3	GND_4	W19.Black	⬛	22 AWG	
APPS_2.1	FRONT_BULKHEAD.19	W20.Red	🟥	22 AWG	
APPS_2.2	FRONT_BULKHEAD.20	W21.Blue	🟦	22 AWG	
APPS_2.3	GND_4	W22.Black	⬛	22 AWG	
BPS_FRONT.1	BPS_POWER_5V_PLUS	W3.Red	🟥	22 AWG	
BPS_FRONT.2	FRONT_BULKHEAD.26	W90.Brown	🟫	22 AWG	
BPS_FRONT.3	BPS_POWER_5V_MINUS	W5.Gray	▨	22 AWG	
BPS_POWER_5V_PLUS	BPS_FRONT.1	W3.Red	🟥	22 AWG	
BPS_POWER_5V_PLUS	BPS_REAR.1	W60.Red	🟥	22 AWG	
BPS_POWER_5V_PLUS	FRONT_BULKHEAD.24	W9.Red	🟥	22 AWG	
BPS_REAR.1	BPS_POWER_5V_PLUS	W60.Red	🟥	22 AWG	
BPS_REAR.2	FRONT_BULKHEAD.27	W91.Brown	🟫	22 AWG	
BPS_REAR.3	BPS_POWER_5V_MINUS	W4.Gray	▨	22 AWG	
BRAKE_OVER_TRAVEL.1	E_STOP	W23.Yellow	🟨	22 AWG	
BRAKE_OVER_TRAVEL.2	GND_4	W24.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
FRONT_BULKHEAD.1	INTER_GND	W34.Black	⬛	18 AWG	
FRONT_BULKHEAD.2	DATA_PORT.13	W37.Green	🟩	22 AWG	
FRONT_BULKHEAD.3	DATA_PORT.12	W44.Yellow	🟨	22 AWG	
FRONT_BULKHEAD.4	DATA_PORT.4	W38.Yellow	🟨	22 AWG	
FRONT_BULKHEAD.5	DATA_PORT.5	W36.Green	🟩	22 AWG	
FRONT_BULKHEAD.6	CAN_3PLUS	W32.Yellow	🟨	22 AWG	
FRONT_BULKHEAD.7	CAN_3MINUS	W33.Green	🟩	22 AWG	
FRONT_BULKHEAD.9	POWER_12V_1	W100.Red	🟥	22 AWG	
FRONT_BULKHEAD.9	STEERING_ANGLE.1	W56.Red	🟥	22 AWG	
FRONT_BULKHEAD.10	POWER_12V_2	W101.Red	🟥	22 AWG	
FRONT_BULKHEAD.11	SW_POWER	W55.Red	🟥	18 AWG	
FRONT_BULKHEAD.12	GND_3	W103.Black	⬛	22 AWG	
FRONT_BULKHEAD.13	POWER_SWITCH.1	W10.Red	🟥	18 AWG	
FRONT_BULKHEAD.14	POWER_SWITCH.2	W95.Brown	🟫	22 AWG	
FRONT_BULKHEAD.15	E_STOP	W25.Yellow	🟨	22 AWG	
FRONT_BULKHEAD.16	POWER_SWITCH.4	W13.Blue	🟦	22 AWG	
FRONT_BULKHEAD.17	APPS_1.1	W17.Red	🟥	22 AWG	
FRONT_BULKHEAD.18	APPS_1.2	W18.Blue	🟦	22 AWG	
FRONT_BULKHEAD.19	APPS_2.1	W20.Red	🟥	22 AWG	
FRONT_BULKHEAD.20	APPS_2.2	W21.Blue	🟦	22 AWG	
FRONT_BULKHEAD.21	SW_POWER	W1.Red	🟥	18 AWG	
FRONT_BULKHEAD.22	STEERING_WHEEL_SPA.3	W97.Brown	🟫	22 AWG	
FRONT_BULKHEAD.23	STEERING_WHEEL_SPA.4	W29.Blue	🟦	22 AWG	
FRONT_BULKHEAD.24	BPS_POWER_5V_PLUS	W9.Red	🟥	22 AWG	
FRONT_BULKHEAD.25	BPS_POWER_5V_MINUS	W8.Gray	▨	22 AWG	
FRONT_BULKHEAD.26	BPS_FRONT.2	W90.Brown	🟫	22 AWG	
FRONT_BULKHEAD.27	BPS_REAR.2	W91.Brown	🟫	22 AWG	
FRONT_BULKHEAD.28	STEERING_WHEEL_SPA.6	W31.Black	⬛	22 AWG	
FRONT_BULKHEAD.29	GND_1	W16.Black	⬛	22 AWG	
FRONT_BULKHEAD.30	STEERING_ANGLE.2	W57.Blue	🟦	22 AWG	
FRONT_BULKHEAD.31	DATA_PORT.7	W65.White	⬜	22 AWG	
FRONT_BULKHEAD.32	DATA_PORT.6	W64.Violet	🟪	22 AWG	
FRONT_BULKHEAD.33	WHEEL_SPEED_FL.2	W89.Blue	🟦	22 AWG	
FRONT_BULKHEAD.34	WHEEL_SPEED_FR.2	W50.Blue	🟦	22 AWG	
FRONT_BULKHEAD.35	SHOCK_POT_FR.2	W51.Blue	🟦	22 AWG	
FRONT_BULKHEAD.36	SHOCK_POT_FL.2	W82.Blue	🟦	22 AWG	
FRONT_BULKHEAD.37	GND_4	W105.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge
CAN_3MINUS	DATA_PORT.2	W40.Green	🟩	22 AWG
CAN_3MINUS	FL_TIRE_TEMP.3	W77.Green	🟩	22 AWG
CAN_3MINUS	FRONT_BULKHEAD.7	W33.Green	🟩	22 AWG
CAN_3MINUS	FR_TIRE_TEMP.3	W80.Green	🟩	22 AWG
CAN_3MINUS	STEERING_WHEEL_SPA.5	W30.Green	🟩	22 AWG
CAN_3PLUS	DATA_PORT.1	W39.Yellow	🟨	22 AWG
CAN_3PLUS	FL_TIRE_TEMP.2	W53.Yellow	🟨	22 AWG
CAN_3PLUS	FRONT_BULKHEAD.6	W32.Yellow	🟨	22 AWG
CAN_3PLUS	FR_TIRE_TEMP.2	W79.Yellow	🟨	22 AWG
CAN_3PLUS	STEERING_WHEEL_SPA.2	W27.Yellow	🟨	22 AWG

From	To	Conductor	Color	Gauge
INTER_GND	FRONT_BULKHEAD.1	W34.Black	⬛	18 AWG
INTER_GND	GND_2	W2.Black	⬛	18 AWG
INTER_GND	STEERING_ANGLE.3	W58.Black	⬛	18 AWG

From	To	Conductor	Color	Gauge
SW_POWER	FRONT_BULKHEAD.11	W55.Red	🟥	18 AWG
SW_POWER	FRONT_BULKHEAD.21	W1.Red	🟥	18 AWG
SW_POWER	STEERING_WHEEL_SPA.1	W26.Red	🟥	22 AWG

From	To	Conductor	Color	Gauge
GND_2	FR_TIRE_TEMP.4	W81.Black	⬛	22 AWG
GND_2	INTER_GND	W2.Black	⬛	18 AWG
GND_2	SHOCK_POT_FR.3	W52.Black	⬛	22 AWG
GND_2	WHEEL_SPEED_FR.3	W70.Black	⬛	18 AWG

From	To	Conductor	Color	Gauge
POWER_12V_2	FRONT_BULKHEAD.10	W101.Red	🟥	22 AWG
POWER_12V_2	FR_TIRE_TEMP.1	W78.Red	🟥	22 AWG
POWER_12V_2	SHOCK_POT_FR.1	W74.Red	🟥	22 AWG
POWER_12V_2	WHEEL_SPEED_FR.1	W67.Red	🟥	22 AWG

From	To	Conductor	Color	Gauge	From Contact PN
FR_TIRE_TEMP.1	POWER_12V_2	W78.Red	🟥	22 AWG	
FR_TIRE_TEMP.2	CAN_3PLUS	W79.Yellow	🟨	22 AWG	
FR_TIRE_TEMP.3	CAN_3MINUS	W80.Green	🟩	22 AWG	
FR_TIRE_TEMP.4	GND_2	W81.Black	⬛	22 AWG	
SHOCK_POT_FR.1	POWER_12V_2	W74.Red	🟥	22 AWG	
SHOCK_POT_FR.2	FRONT_BULKHEAD.35	W51.Blue	🟦	22 AWG	
SHOCK_POT_FR.3	GND_2	W52.Black	⬛	22 AWG	
WHEEL_SPEED_FR.1	POWER_12V_2	W67.Red	🟥	22 AWG	
WHEEL_SPEED_FR.2	FRONT_BULKHEAD.34	W50.Blue	🟦	22 AWG	
WHEEL_SPEED_FR.3	GND_2	W70.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
STEERING_ANGLE.1	FRONT_BULKHEAD.9	W56.Red	🟥	22 AWG	
STEERING_ANGLE.2	FRONT_BULKHEAD.30	W57.Blue	🟦	22 AWG	
STEERING_ANGLE.3	INTER_GND	W58.Black	⬛	18 AWG	

Bill of Materials

Id	Type	Manufacturer	Part Number	Quantity
1	Connector		ECU 32 PIN	2
2	Connector		ASM-CON-042 48 PIN MOLEX	2
3	Connector	TE Connectivity / DEUTSCH	2366494-1	1
4	Connector	TE Connectivity / DEUTSCH	HD36-24-23ST	1
5	Connector	Souriau	8STA61435PN	1
8	Connector	TE Connectivity / DEUTSCH	AS608-35SN-903M	1
9	Connector	Souriau	8STA61235SN	1
10	Wire		UL1015 22 AWG Blue	
11	Wire		UL1015 22 AWG Violet	
12	Wire		UL1015 22 AWG Orange	
13	Wire		UL1007 22 AWG Orange	
14	Wire		UL1015 22 AWG Black	
15	Wire		UL1015 22 AWG Gray	
16	Wire		UL1007 22 AWG Blue	
17	Wire		UL1007 22 AWG Gray	0 in
19	Wire		UL1061 22 AWG Violet	
20	Splice			2
21	Wire		UL1015 22 AWG Green	
22	Wire		UL1015 22 AWG Yellow	
23	Wire		UL1007 22 AWG Yellow	
24	Wire		UL1007 22 AWG Green	
25	Ring Terminal	Panduit	EV18-10RB-Q	1
26	Wire		UL1061 22 AWG Blue	
27	Wire		UL1007 22 AWG Red	
28	Wire		UL1015 22 AWG Red	
29	Wire		M22759/32-22-6	
30	Wire		M22759/32-22-3	≥ 0 in
31	Wire		M22759/32-22-2	≥ 0 in
32	Wire		M22759/32-22-0	
33	Wire		M22759/32-22-4	≥ 0 in
34	Wire		M22759/32-22-5	≥ 0 in
35	Wire		M22759/32-22-8	≥ 0 in
36	Splice	TE Connectivity / DEUTSCH	DTM04-2P-P007	1
37	Connector	TE Connectivity - Deutsch	DTM04-2S	1
38	Connector	TE Connectivity - Deutsch	DTM04-4S	1
39	Wire	Nexans	M22759/32-22-0	≥ 0 in
40	Wire		M22759/32-22-9	

om	To	Conductor	Color	Gauge	From Contact PN
AR_POWER_BULKHEAD.A	SPDU.A3	W79.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.B	ECU_C.H1	W88.Black	■	22 AWG	
AR_POWER_BULKHEAD.C	SPDU.K1	W85.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.D	ECU_B.L1	W91.Black	■	22 AWG	
AR_POWER_BULKHEAD.E	SPDU.K2	W86.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.F	ECU_B.M3	W92.Black	■	22 AWG	
AR_POWER_BULKHEAD.G	SPDU.A4	W80.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.H	SPDU.F1	W87.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.K	SPDU.F3	W113.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.L	SPDU.F4	W114.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.M	ECU_A.H4	W93.Black	■	22 AWG	
AR_POWER_BULKHEAD.N	ECU_A.H3	W12.Black	■	22 AWG	
AR_POWER_BULKHEAD.O	SPDU.A2	W115.Red	🟥	22 AWG	
AR_POWER_BULKHEAD.S	ECU_C.G1	W89.Black	■	22 AWG	
AR_POWER_BULKHEAD.T	ECU_C.G2	W90.Black	■	22 AWG	

Rear

From	To	Conductor	Color	Gauge	From Contact PN
REAR_SIGNAL_BULKHEAD.1	ECU_A.F1	W9.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.2	ECU_B.J2	W48.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.2	SPDU.B4	W41.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.3	ECU_B.E4	W21.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.4	ECU_B.J4	W59.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.6	ECU_B.K3	W58.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.7	ECU_B.L2	W40.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.8	ECU_C.D2	W2.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.9	ECU_A.D1	W6.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.10	ECU_B.E2	W37.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.11	EVO_BIG.26	W55.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.12	EVO_BIG.22	W36.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.14	ECU_A.D4	W8.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.15	ECU_A.C4	W5.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.16	ECU_B.E1	W3.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.17	FRONTBULKHEAD.34	W60.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.18	FRONTBULKHEAD.33	W61.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.19	EVO_SMALL.11	W62.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.20	EVO_BIG.19	W63.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.21	ECU_B.D2	W64.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.22	ECU_B.D4	W65.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.23	ECU_B.K1	W66.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.24	ECU_B.C1	W67.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.25	ECU_B.K4	W69.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.26	ECU_C.F1	W53.Red	🟥	22 AWG	
REAR_SIGNAL_BULKHEAD.27	ECU_C.E1	W57.Black	■	22 AWG	
REAR_SIGNAL_BULKHEAD.28	ECU_C.B1	W46.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.29	ECU_B.C3	W83.Red	🟥	22 AWG	
REAR_SIGNAL_BULKHEAD.30	ECU_B.B1	W16.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.31	ECU_B.B2	W17.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.32	ECU_B.B3	W109.Gray	▨	22 AWG	
REAR_SIGNAL_BULKHEAD.33	ECU_B.A1	W84.Red	🟥	22 AWG	
REAR_SIGNAL_BULKHEAD.34	ECU_B.A2	W13.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.35	ECU_B.A3	W14.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.36	ECU_B.A4	W15.Gray	▨	22 AWG	
REAR_SIGNAL_BULKHEAD.37	CAN3_H	W25.Yellow	🟨	22 AWG	
REAR_SIGNAL_BULKHEAD.38	CAN3_L	W27.Green	🟩	22 AWG	
REAR_SIGNAL_BULKHEAD.39	ECU_A.C1	W4.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.40	ECU_C.F3	W51.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.41	ECU_C.C4	W39.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.42	ECU_C.A1	W44.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.43	ECU_C.F4	W47.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.44	ECU_B.K2	W38.Orange	🟧	22 AWG	
REAR_SIGNAL_BULKHEAD.45	ECU_B.D3	W20.Blue	🟦	22 AWG	
REAR_SIGNAL_BULKHEAD.48	ECU_B.M2	W42.Blue	🟦	22 AWG	

Front

From	To	Conductor	Color	Gauge	From Contact PN
FRONTBULKHEAD.1	GND	W94.Black	■	22 AWG	
FRONTBULKHEAD.2	ECU_B.G1	W29.Green	🟩	22 AWG	
FRONTBULKHEAD.3	ECU_B.G2	W30.Yellow	🟨	22 AWG	
FRONTBULKHEAD.4	ECU_B.H2	W32.Yellow	🟨	22 AWG	
FRONTBULKHEAD.5	ECU_B.H1	W31.Green	🟩	22 AWG	
FRONTBULKHEAD.6	CAN3_H	W26.Yellow	🟨	22 AWG	
FRONTBULKHEAD.7	CAN3_L	W28.Green	🟩	22 AWG	
FRONTBULKHEAD.9	SPDU.E1	W122.Red	🟥	22 AWG	
FRONTBULKHEAD.10	SPDU.E2	W123.Red	🟥	22 AWG	
FRONTBULKHEAD.11	SPDU.F2	W112.Red	🟥	22 AWG	
FRONTBULKHEAD.12	GND	W132.Black	■	22 AWG	
FRONTBULKHEAD.13	SPDU.C2	W121.Red	🟥	22 AWG	
FRONTBULKHEAD.14	ECU_C.C1	W68.Orange	🟧	22 AWG	
FRONTBULKHEAD.15	ECU_A.D3	W7.Violet	🟪	22 AWG	
FRONTBULKHEAD.16	ECU_B.G4	W43.Blue	🟦	22 AWG	
FRONTBULKHEAD.17	SPDU.B1	W118.Red	🟥	22 AWG	
FRONTBULKHEAD.18	ECU_B.H4	W34.Blue	🟦	22 AWG	
FRONTBULKHEAD.19	SPDU.B2	W119.Red	🟥	22 AWG	
FRONTBULKHEAD.20	ECU_B.J1	W35.Blue	🟦	22 AWG	
FRONTBULKHEAD.21	SPDU.F2	W124.Red	🟥	22 AWG	
FRONTBULKHEAD.22	ECU_B.F3	W10.Orange	🟧	22 AWG	
FRONTBULKHEAD.23	ECU_B.G3	W11.Orange	🟧	22 AWG	
FRONTBULKHEAD.24	ECU_C.E4	W81.Red	🟥	22 AWG	
FRONTBULKHEAD.25	ECU_C.E3	W108.Gray	▨	22 AWG	
FRONTBULKHEAD.26	ECU_C.B4	W49.Orange	🟧	22 AWG	
FRONTBULKHEAD.26	SPDU.B3	W50.Orange	🟧	22 AWG	
FRONTBULKHEAD.27	ECU_B.C2	W19.Orange	🟧	22 AWG	
FRONTBULKHEAD.27	ECU_C.B4	W52.Blue	🟦	22 AWG	
FRONTBULKHEAD.28	GND	W133.Black	■	22 AWG	
FRONTBULKHEAD.29	GND	W134.Black	■	22 AWG	
FRONTBULKHEAD.30	EVO_SMALL.10	W70.Orange	🟧	22 AWG	
FRONTBULKHEAD.31	EVO_BIG.13	W139.White	□	22 AWG	
FRONTBULKHEAD.32	EVO_BIG.12	W22.Violet	🟪	22 AWG	
FRONTBULKHEAD.33	REAR_SIGNAL_BULKHEAD.18	W61.Blue	🟦	22 AWG	
FRONTBULKHEAD.34	REAR_SIGNAL_BULKHEAD.17	W60.Blue	🟦	22 AWG	
FRONTBULKHEAD.35	EVO_BIG.34	W56.Blue	🟦	22 AWG	
FRONTBULKHEAD.36	EVO_BIG.30	W54.Orange	🟧	22 AWG	
FRONTBULKHEAD.37	GND	W140.White	□	22 AWG	

EVO

From	To	Conductor	Color	Gauge	From Contact PN
EVO_BIG.1	SPDU.D1	W117.Red	🟥	22 AWG	
EVO_BIG.12	FRONTBULKHEAD.32	W22.Violet	🟪	22 AWG	
EVO_BIG.13	FRONTBULKHEAD.31	W139.White	□	22 AWG	
EVO_BIG.19	REAR_SIGNAL_BULKHEAD.20	W63.Blue	🟦	22 AWG	
EVO_BIG.22	REAR_SIGNAL_BULKHEAD.12	W36.Blue	🟦	22 AWG	
EVO_BIG.26	REAR_SIGNAL_BULKHEAD.11	W55.Orange	🟧	22 AWG	
EVO_BIG.30	FRONTBULKHEAD.36	W54.Orange	🟧	22 AWG	
EVO_BIG.34	FRONTBULKHEAD.35	W56.Blue	🟦	22 AWG	
EVO_SMALL.10	FRONTBULKHEAD.30	W70.Orange	🟧	22 AWG	
EVO_SMALL.11	REAR_SIGNAL_BULKHEAD.19	W62.Blue	🟦	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SPDU.A1	ECU_C.H2	W78.Red	🟥	22 AWG	
SPDU.A2	REAR_POWER_BULKHEAD.O	W115.Red	🟥	22 AWG	
SPDU.A3	REAR_POWER_BULKHEAD.A	W79.Red	🟥	22 AWG	
SPDU.A4	REAR_POWER_BULKHEAD.G	W80.Red	🟥	22 AWG	
SPDU.B1	FRONTBULKHEAD.17	W118.Red	🟥	22 AWG	
SPDU.B2	FRONTBULKHEAD.19	W119.Red	🟥	22 AWG	
SPDU.B3	FRONTBULKHEAD.26	W50.Orange	🟧	22 AWG	
SPDU.B4	REAR_SIGNAL_BULKHEAD.2	W41.Orange	🟧	22 AWG	
SPDU.C1	ECU_C.A4	W45.Red	🟥	22 AWG	
SPDU.C2	FRONTBULKHEAD.13	W121.Red	🟥	22 AWG	
SPDU.C4	GND	W95.Black	■	22 AWG	
SPDU.D1	EVO_BIG.1	W117.Red	🟥	22 AWG	
SPDU.D2	IMU.1	W120.Red	🟥	22 AWG	
SPDU.D3	ECU_A.A2	W1.Blue	🟦	22 AWG	
SPDU.D4	GND	W97.Black	■	22 AWG	
SPDU.E1	FRONTBULKHEAD.9	W122.Red	🟥	22 AWG	
SPDU.E2	FRONTBULKHEAD.10	W123.Red	🟥	22 AWG	
SPDU.F1	REAR_POWER_BULKHEAD.H	W87.Red	🟥	22 AWG	
SPDU.F2	FRONTBULKHEAD.11	W112.Red	🟥	22 AWG	
SPDU.F2	FRONTBULKHEAD.21	W124.Red	🟥	22 AWG	
SPDU.F3	REAR_POWER_BULKHEAD.K	W113.Red	🟥	22 AWG	
SPDU.F4	REAR_POWER_BULKHEAD.L	W114.Red	🟥	22 AWG	
SPDU.G1	ECU_C.G3	W82.Red	🟥	22 AWG	
SPDU.H2	FAN.1	W116.Red	🟥	22 AWG	
SPDU.K1	REAR_POWER_BULKHEAD.C	W85.Red	🟥	22 AWG	
SPDU.K2	REAR_POWER_BULKHEAD.E	W86.Red	🟥	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
IMU.1	SPDU.D2	W120.Red	🟥	22 AWG	
IMU.2	CAN3_H	W99.Yellow	🟨	22 AWG	
IMU.3	CAN3_L	W103.Green	🟩	22 AWG	
IMU.4	GND	W96.Black	■	22 AWG	

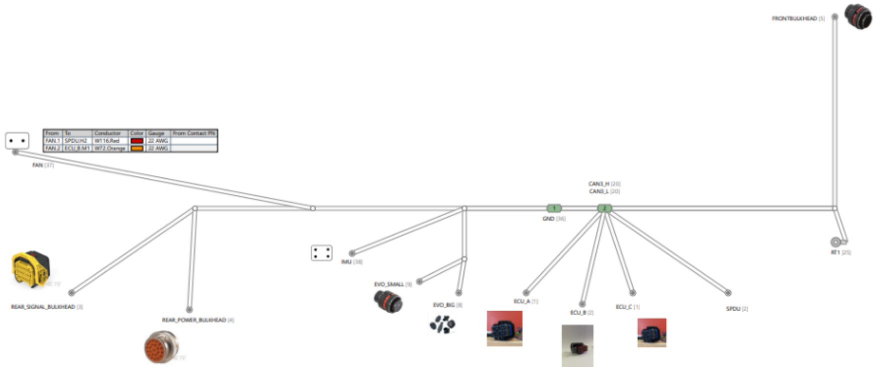
ECU

From	To	Conductor	Color	Gauge	From Contact PN
ECU_A.A2	SPDU.D3	W1.Blue	🟦	22 AWG	
ECU_A.C1	REAR_SIGNAL_BULKHEAD.39	W4.Blue	🟦	22 AWG	
ECU_A.C4	REAR_SIGNAL_BULKHEAD.15	W5.Blue	🟦	22 AWG	
ECU_A.D1	REAR_SIGNAL_BULKHEAD.9	W6.Blue	🟦	22 AWG	
ECU_A.D3	FRONTBULKHEAD.15	W7.Violet	🟪	22 AWG	
ECU_A.D4	REAR_SIGNAL_BULKHEAD.14	W8.Orange	🟧	22 AWG	
ECU_A.F1	REAR_SIGNAL_BULKHEAD.1	W9.Blue	🟦	22 AWG	
ECU_A.H3	REAR_POWER_BULKHEAD.N	W12.Black	■	22 AWG	
ECU_A.H4	REAR_POWER_BULKHEAD.M	W93.Black	■	22 AWG	
ECU_B.A1	REAR_SIGNAL_BULKHEAD.33	W84.Red	🟥	22 AWG	
ECU_B.A2	REAR_SIGNAL_BULKHEAD.34	W13.Orange	🟧	22 AWG	
ECU_B.A3	REAR_SIGNAL_BULKHEAD.35	W14.Blue	🟦	22 AWG	
ECU_B.A4	REAR_SIGNAL_BULKHEAD.36	W15.Gray	▨	22 AWG	
ECU_B.B1	REAR_SIGNAL_BULKHEAD.30	W16.Orange	🟧	22 AWG	
ECU_B.B2	REAR_SIGNAL_BULKHEAD.31	W17.Blue	🟦	22 AWG	
ECU_B.B3	REAR_SIGNAL_BULKHEAD.32	W109.Gray	▨	22 AWG	
ECU_B.C1	REAR_SIGNAL_BULKHEAD.24	W67.Blue	🟦	22 AWG	
ECU_B.C2	FRONTBULKHEAD.27	W19.Orange	🟧	22 AWG	
ECU_B.C3	REAR_SIGNAL_BULKHEAD.29	W83.Red	🟥	22 AWG	
ECU_B.D2	REAR_SIGNAL_BULKHEAD.21	W64.Blue	🟦	22 AWG	
ECU_B.D3	REAR_SIGNAL_BULKHEAD.45	W20.Blue	🟦	22 AWG	
ECU_B.D4	REAR_SIGNAL_BULKHEAD.22	W65.Blue	🟦	22 AWG	
ECU_B.E1	REAR_SIGNAL_BULKHEAD.16	W3.Blue	🟦	22 AWG	
ECU_B.E2	REAR_SIGNAL_BULKHEAD.10	W37.Orange	🟧	22 AWG	
ECU_B.E4	REAR_SIGNAL_BULKHEAD.3	W21.Orange	🟧	22 AWG	
ECU_B.F1	CAN3_L	W23.Green	🟩	22 AWG	
ECU_B.F2	CAN3_H	W24.Yellow	🟨	22 AWG	
ECU_B.F3	FRONTBULKHEAD.22	W10.Orange	🟧	22 AWG	
ECU_B.G1	FRONTBULKHEAD.2	W29.Green	🟩	22 AWG	
ECU_B.G2	FRONTBULKHEAD.3	W30.Yellow	🟨	22 AWG	
ECU_B.G3	FRONTBULKHEAD.23	W11.Orange	🟧	22 AWG	
ECU_B.G4	FRONTBULKHEAD.16	W43.Blue	🟦	22 AWG	
ECU_B.H1	FRONTBULKHEAD.5	W31.Green	🟩	22 AWG	
ECU_B.H2	FRONTBULKHEAD.4	W32.Yellow	🟨	22 AWG	
ECU_B.H3	RT1	W33.Black	■	22 AWG	
ECU_B.H4	FRONTBULKHEAD.18	W34.Blue	🟦	22 AWG	
ECU_B.J1	FRONTBULKHEAD.20	W35.Blue	🟦	22 AWG	
ECU_B.J2	REAR_SIGNAL_BULKHEAD.2	W48.Orange	🟧	22 AWG	
ECU_B.J4	REAR_SIGNAL_BULKHEAD.4	W59.Blue	🟦	22 AWG	
ECU_B.K1	REAR_SIGNAL_BULKHEAD.23	W66.Blue	🟦	22 AWG	
ECU_B.K2	REAR_SIGNAL_BULKHEAD.44	W38.Orange	🟧	22 AWG	
ECU_B.K3	REAR_SIGNAL_BULKHEAD.6	W58.Blue	🟦	22 AWG	
ECU_B.K4	REAR_SIGNAL_BULKHEAD.25	W69.Orange	🟧	22 AWG	
ECU_B.L1	REAR_POWER_BULKHEAD.D	W91.Black	■	22 AWG	
ECU_B.L2	REAR_SIGNAL_BULKHEAD.7	W40.Orange	🟧	22 AWG	
ECU_B.M1	FAN.2	W72.Orange	🟧	22 AWG	
ECU_B.M2	REAR_SIGNAL_BULKHEAD.48	W42.Blue	🟦	22 AWG	
ECU_B.M3	REAR_POWER_BULKHEAD.F	W92.Black	■	22 AWG	
ECU_C.A1	REAR_SIGNAL_BULKHEAD.42	W44.Blue	🟦	22 AWG	
ECU_C.A4	SPDU.C1	W45.Red	🟥	22 AWG	
ECU_C.B1	REAR_SIGNAL_BULKHEAD.28	W46.Blue	🟦	22 AWG	
ECU_C.B4	FRONTBULKHEAD.26	W49.Orange	🟧	22 AWG	
ECU_C.B4	FRONTBULKHEAD.27	W52.Blue	🟦	22 AWG	
ECU_C.C1	FRONTBULKHEAD.14	W68.Orange	🟧	22 AWG	
ECU_C.C4	REAR_SIGNAL_BULKHEAD.41	W39.Blue	🟦	22 AWG	
ECU_C.D2	REAR_SIGNAL_BULKHEAD.8	W2.Blue	🟦	22 AWG	
ECU_C.E1	REAR_SIGNAL_BULKHEAD.27	W57.Black	■	22 AWG	
ECU_C.E3	FRONTBULKHEAD.25	W108.Gray	▨	22 AWG	
ECU_C.E4	FRONTBULKHEAD.24	W81.Red	🟥	22 AWG	
ECU_C.F1	REAR_SIGNAL_BULKHEAD.26	W53.Red	🟥	22 AWG	
ECU_C.F3	REAR_SIGNAL_BULKHEAD.40	W51.Orange	🟧	22 AWG	
ECU_C.F4	REAR_SIGNAL_BULKHEAD.43	W47.Orange	🟧	22 AWG	
ECU_C.G1	REAR_POWER_BULKHEAD.S	W89.Black	■	22 AWG	
ECU_C.G2	REAR_POWER_BULKHEAD.T	W90.Black	■	22 AWG	
ECU_C.G3	SPDU.G1	W82.Red	🟥	22 AWG	
ECU_C.H1	REAR_POWER_BULKHEAD.B	W88.Black	■	22 AWG	
ECU_C.H2	SPDU.A1	W78.Red	🟥	22 AWG	

CAN

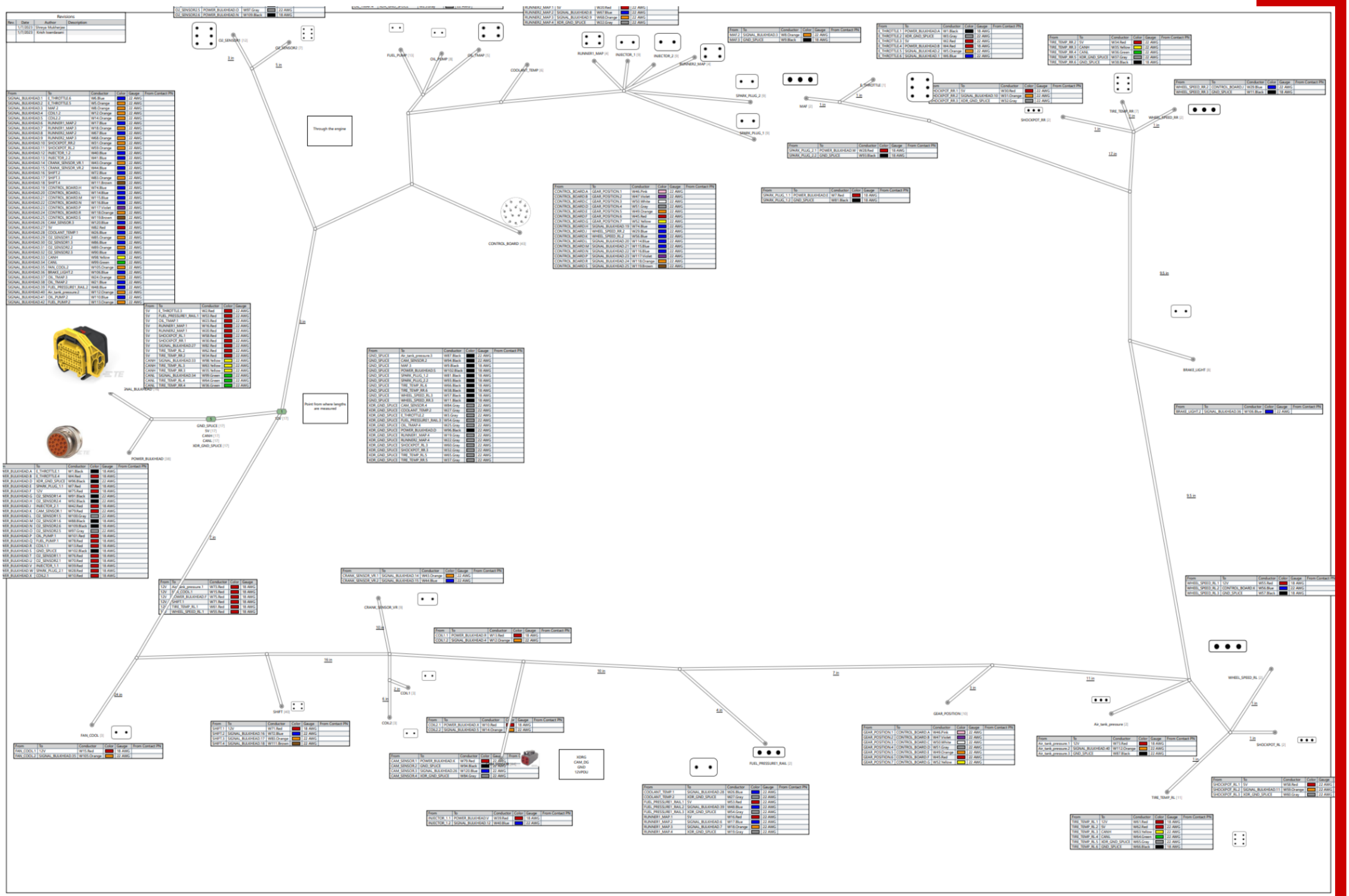
From	To	Conductor	Color	Gauge
CAN3_H	ECU_B.F2	W24.Yellow	🟨	22 AWG
CAN3_H	FRONTBULKHEAD.6	W26.Yellow	🟨	22 AWG
CAN3_H	IMU.2	W99.Yellow	🟨	22 AWG
CAN3_H	REAR_SIGNAL_BULKHEAD.37	W25.Yellow	🟨	22 AWG
CAN3_L	ECU_B.F1	W23.Green	🟩	22 AWG
CAN3_L	FRONTBULKHEAD.7	W28.Green	🟩	22 AWG
CAN3_L	IMU.3	W103.Green	🟩	22 AWG
CAN3_L	REAR_SIGNAL_BULKHEAD.38	W27.Green	🟩	22 AWG

From	To	Conductor	Color	Gauge
RT1	ECU_B.H3	W33.Black	■	22 AWG



From	To	Conductor	Color	Gauge	From Contact PN
FAN.1	SPDU.H2	W116.Red	🟥	22 AWG	
FAN.2	ECU_B.M1	W72.Orange	🟧	22 AWG	

From	To	Conductor	Color	Gauge
GND	FRONTBULKHEAD.1	W94.Black	■	22 AWG
GND	FRONTBULKHEAD.12	W132.Black	■	22 AWG
GND	FRONTBULKHEAD.28	W133.Black	■	22 AWG
GND	FRONTBULKHEAD.29	W134.Black	■	22 AWG
GND	FRONTBULKHEAD.37	W140.White	□	22 AWG
GND	IMU.4	W96.Black	■	22 AWG
GND	SPDU.C4	W95.Black	■	22 AWG
GND	SPDU.D4	W97.Black	■	22 AWG



Revisions			
Rev.	Date	Author	Description
	1/7/2023	Shreya Mukherjee	
	1/7/2023	Krish Isserdasani	

O2_SENSOR2.5	POWER_BULKHEAD.O	W97.Gray	▨	22 AWG	
O2_SENSOR2.6	POWER_BULKHEAD.N	W109.Black	⬛	18 AWG	

OIL_TMAP.4	XDR_GND_SPLICE	W25.Gray	▨	22 AWG	

RUNNER2_MAP.1	5V	W20.Red	🟥	22 AWG	
RUNNER2_MAP.2	SIGNAL_BULKHEAD.8	W67.Blue	🟦	22 AWG	
RUNNER2_MAP.3	SIGNAL_BULKHEAD.9	W68.Orange	🟧	22 AWG	
RUNNER2_MAP.4	XDR_GND_SPLICE	W22.Gray	▨	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
MAF.2	SIGNAL_BULKHEAD.3	W8.Orange	🟧	22 AWG	
MAF.3	GND_SPLICE	W9.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
E_THROTTLE.1	POWER_BULKHEAD.A	W1.Black	⬛	18 AWG	
E_THROTTLE.2	XDR_GND_SPLICE	W3.Gray	▨	22 AWG	
E_THROTTLE.3	5V	W2.Red	🟥	22 AWG	
E_THROTTLE.4	POWER_BULKHEAD.B	W4.Red	🟥	18 AWG	
E_THROTTLE.5	SIGNAL_BULKHEAD.2	W5.Orange	🟧	22 AWG	
E_THROTTLE.6	SIGNAL_BULKHEAD.1	W6.Blue	🟦	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
TIRE_TEMP_RR.2	5V	W34.Red	🟥	22 AWG	
TIRE_TEMP_RR.3	CANH	W35.Yellow	🟨	22 AWG	
TIRE_TEMP_RR.4	CANL	W36.Green	🟩	22 AWG	
TIRE_TEMP_RR.5	XDR_GND_SPLICE	W37.Gray	▨	22 AWG	
TIRE_TEMP_RR.6	GND_SPLICE	W38.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SHOCKPOT_RR.1	5V	W30.Red	🟥	22 AWG	
SHOCKPOT_RR.2	SIGNAL_BULKHEAD.10	W31.Orange	🟧	22 AWG	
SHOCKPOT_RR.3	XDR_GND_SPLICE	W32.Gray	▨	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
WHEEL_SPEED_RR.2	CONTROL_BOARD.J	W29.Blue	🟦	22 AWG	
WHEEL_SPEED_RR.3	GND_SPLICE	W11.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SPARK_PLUG_2.1	POWER_BULKHEAD.W	W28.Red	🟥	18 AWG	
SPARK_PLUG_2.2	GND_SPLICE	W93.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SPARK_PLUG_1.1	POWER_BULKHEAD.E	W7.Red	🟥	18 AWG	
SPARK_PLUG_1.2	GND_SPLICE	W81.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SIGNAL_BULKHEAD.1	E_THROTTLE.6	W6.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.2	E_THROTTLE.5	W5.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.3	MAF.2	W8.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.4	COIL1.2	W12.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.5	COIL2.2	W14.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.6	RUNNER1_MAP.2	W17.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.7	RUNNER1_MAP.3	W18.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.8	RUNNER2_MAP.2	W67.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.9	RUNNER2_MAP.3	W68.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.10	SHOCKPOT_RR.2	W31.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.11	SHOCKPOT_RL.2	W59.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.12	INJECTOR_1.2	W40.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.13	INJECTOR_2.2	W41.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.14	CRANK_SENSOR_VR.1	W43.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.15	CRANK_SENSOR_VR.2	W44.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.16	SHIFT.2	W72.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.17	SHIFT.3	W83.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.18	SHIFT.4	W111.Brown	🟫	22 AWG	
SIGNAL_BULKHEAD.19	CONTROL_BOARD.H	W74.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.20	CONTROL_BOARD.L	W114.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.21	CONTROL_BOARD.M	W115.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.22	CONTROL_BOARD.N	W116.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.23	CONTROL_BOARD.P	W117.Violet	🟪	22 AWG	
SIGNAL_BULKHEAD.24	CONTROL_BOARD.R	W118.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.25	CONTROL_BOARD.S	W119.Brown	🟫	22 AWG	
SIGNAL_BULKHEAD.26	CAM_SENSOR.3	W120.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.27	5V	W82.Red	🟥	22 AWG	
SIGNAL_BULKHEAD.28	COOLANT_TEMP.1	W26.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.29	O2_SENSOR1.2	W85.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.30	O2_SENSOR1.3	W86.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.31	O2_SENSOR2.2	W89.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.32	O2_SENSOR2.3	W90.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.33	CANH	W98.Yellow	🟨	22 AWG	
SIGNAL_BULKHEAD.34	CANL	W99.Green	🟩	22 AWG	
SIGNAL_BULKHEAD.35	FAN_COOL.2	W105.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.36	BRAKE_LIGHT.2	W106.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.37	OIL_TMAP.3	W24.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.38	OIL_TMAP.2	W21.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.39	FUEL_PRESSURE1_RAIL.2	W48.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.40	Air_tank_pressure.2	W112.Orange	🟧	22 AWG	
SIGNAL_BULKHEAD.41	OIL_PUMP.2	W110.Blue	🟦	22 AWG	
SIGNAL_BULKHEAD.42	FUEL_PUMP.2	W113.Orange	🟧	22 AWG	

From	To	Conductor	Color	Gauge
5V	E_THROTTLE.3	W2.Red	🟥	22 AWG
5V	FUEL_PRESSURE1_RAIL.1	W53.Red	🟥	22 AWG
5V	OIL_TMAP.1	W23.Red	🟥	22 AWG
5V	RUNNER1_MAP.1	W16.Red	🟥	22 AWG
5V	RUNNER2_MAP.1	W20.Red	🟥	22 AWG
5V	SHOCKPOT_RL.1	W58.Red	🟥	22 AWG
5V	SHOCKPOT_RR.1	W30.Red	🟥	22 AWG
5V	SIGNAL_BULKHEAD.27	W82.Red	🟥	22 AWG
5V	TIRE_TEMP_RL.2	W62.Red	🟥	22 AWG
5V	TIRE_TEMP_RR.2	W34.Red	🟥	22 AWG
CANH	SIGNAL_BULKHEAD.33	W98.Yellow	🟨	22 AWG
CANH	TIRE_TEMP_RL.3	W63.Yellow	🟨	22 AWG
CANH	TIRE_TEMP_RR.3	W35.Yellow	🟨	22 AWG
CANL	SIGNAL_BULKHEAD.34	W99.Green	🟩	22 AWG
CANL	TIRE_TEMP_RL.4	W64.Green	🟩	22 AWG
CANL	TIRE_TEMP_RR.4	W36.Green	🟩	22 AWG

From	To	Conductor	Color	Gauge	From Contact PN
WER_BULKHEAD.A	E_THROTTLE.1	W1.Black	⬛	18 AWG	
WER_BULKHEAD.B	E_THROTTLE.4	W4.Red	🟥	18 AWG	
WER_BULKHEAD.D	XDR_GND_SPLICE	W96.Black	⬛	22 AWG	
WER_BULKHEAD.E	SPARK_PLUG_1.1	W7.Red	🟥	18 AWG	
WER_BULKHEAD.F	12V	W75.Red	🟥	18 AWG	
WER_BULKHEAD.G	O2_SENSOR1.4	W91.Black	⬛	22 AWG	
WER_BULKHEAD.H	O2_SENSOR2.4	W92.Black	⬛	22 AWG	
WER_BULKHEAD.J	INJECTOR_2.1	W42.Red	🟥	18 AWG	
WER_BULKHEAD.K	CAM_SENSOR.1	W79.Red	🟥	22 AWG	
WER_BULKHEAD.L	O2_SENSOR1.5	W100.Gray	▨	22 AWG	
WER_BULKHEAD.M	O2_SENSOR1.6	W88.Black	⬛	18 AWG	
WER_BULKHEAD.N	O2_SENSOR2.6	W109.Black	⬛	18 AWG	
WER_BULKHEAD.O	O2_SENSOR2.5	W97.Gray	▨	22 AWG	
WER_BULKHEAD.P	OIL_PUMP.1	W101.Red	🟥	18 AWG	
WER_BULKHEAD.Q	FUEL_PUMP.1	W78.Red	🟥	18 AWG	
WER_BULKHEAD.R	COIL1.1	W13.Red	🟥	18 AWG	
WER_BULKHEAD.S	GND_SPLICE	W102.Black	⬛	18 AWG	
WER_BULKHEAD.T	O2_SENSOR1.1	W76.Red	🟥	18 AWG	
WER_BULKHEAD.U	O2_SENSOR2.1	W70.Red	🟥	18 AWG	
WER_BULKHEAD.V	INJECTOR_1.1	W39.Red	🟥	18 AWG	
WER_BULKHEAD.W	SPARK_PLUG_2.1	W28.Red	🟥	18 AWG	
WER_BULKHEAD.X	COIL2.1	W10.Red	🟥	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
GND_SPLICE	Air_tank_pressure.3	W87.Black	⬛	22 AWG	
GND_SPLICE	CAM_SENSOR.2	W94.Black	⬛	22 AWG	
GND_SPLICE	MAF.3	W9.Black	⬛	18 AWG	
GND_SPLICE	POWER_BULKHEAD.S	W102.Black	⬛	18 AWG	
GND_SPLICE	SPARK_PLUG_1.2	W81.Black	⬛	18 AWG	
GND_SPLICE	SPARK_PLUG_2.2	W93.Black	⬛	18 AWG	
GND_SPLICE	TIRE_TEMP_RL.6	W66.Black	⬛	18 AWG	
GND_SPLICE	TIRE_TEMP_RR.6	W38.Black	⬛	18 AWG	
GND_SPLICE	WHEEL_SPEED_RL.3	W57.Black	⬛	18 AWG	
GND_SPLICE	WHEEL_SPEED_RR.3	W11.Black	⬛	18 AWG	
XDR_GND_SPLICE	CAM_SENSOR.4	W84.Gray	▨	22 AWG	
XDR_GND_SPLICE	COOLANT_TEMP.2	W27.Gray	▨	22 AWG	
XDR_GND_SPLICE	E_THROTTLE.2	W3.Gray	▨	22 AWG	
XDR_GND_SPLICE	FUEL_PRESSURE1_RAIL.3	W54.Gray	▨	22 AWG	
XDR_GND_SPLICE	OIL_TMAP.4	W25.Gray	▨	22 AWG	
XDR_GND_SPLICE	POWER_BULKHEAD.D	W96.Black	⬛	22 AWG	
XDR_GND_SPLICE	RUNNER1_MAP.4	W19.Gray	▨	22 AWG	
XDR_GND_SPLICE	RUNNER2_MAP.4	W22.Gray	▨	22 AWG	
XDR_GND_SPLICE	SHOCKPOT_RL.3	W60.Gray	▨	22 AWG	
XDR_GND_SPLICE	SHOCKPOT_RR.3	W32.Gray	▨	22 AWG	
XDR_GND_SPLICE	TIRE_TEMP_RL.5	W65.Gray	▨	22 AWG	
XDR_GND_SPLICE	TIRE_TEMP_RR.5	W37.Gray	▨	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
CONTROL_BOARD.A	GEAR_POSITION.1	W46.Pink	▧	22 AWG	
CONTROL_BOARD.B	GEAR_POSITION.2	W47.Violet	🟪	22 AWG	
CONTROL_BOARD.C	GEAR_POSITION.3	W50.White	⬜	22 AWG	
CONTROL_BOARD.D	GEAR_POSITION.4	W51.Gray	▨	22 AWG	
CONTROL_BOARD.E	GEAR_POSITION.5	W49.Orange	🟧	22 AWG	
CONTROL_BOARD.F	GEAR_POSITION.6	W45.Red	🟥	22 AWG	
CONTROL_BOARD.G	GEAR_POSITION.7	W52.Yellow	🟨	22 AWG	
CONTROL_BOARD.H	SIGNAL_BULKHEAD.19	W74.Blue	🟦	22 AWG	
CONTROL_BOARD.J	WHEEL_SPEED_RR.2	W29.Blue	🟦	22 AWG	
CONTROL_BOARD.K	WHEEL_SPEED_RL.2	W56.Blue	🟦	22 AWG	
CONTROL_BOARD.L	SIGNAL_BULKHEAD.20	W114.Blue	🟦	22 AWG	
CONTROL_BOARD.M	SIGNAL_BULKHEAD.21	W115.Blue	🟦	22 AWG	
CONTROL_BOARD.N	SIGNAL_BULKHEAD.22	W116.Blue	🟦	22 AWG	
CONTROL_BOARD.P	SIGNAL_BULKHEAD.23	W117.Violet	🟪	22 AWG	
CONTROL_BOARD.R	SIGNAL_BULKHEAD.24	W118.Orange	🟧	22 AWG	
CONTROL_BOARD.S	SIGNAL_BULKHEAD.25	W119.Brown	🟫	22 AWG	

From	To	Conductor	Color	Gauge
12V	Air_tank_pressure.1	W73.Red	🟥	18 AWG
12V	FAN_COOL.1	W15.Red	🟥	18 AWG
12V	POWER_BULKHEAD.F	W75.Red	🟥	18 AWG
12V	SHIFT.1	W71.Red	🟥	18 AWG
12V	TIRE_TEMP_RL.1	W61.Red	🟥	18 AWG
12V	WHEEL_SPEED_RL.1	W55.Red	🟥	18 AWG

From	To	Conductor	Color	Gauge	From Contact PN
CRANK_SENSOR_VR.1	SIGNAL_BULKHEAD.14	W43.Orange	🟧	22 AWG	
CRANK_SENSOR_VR.2	SIGNAL_BULKHEAD.15	W44.Blue	🟦	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
COIL1.1	POWER_BULKHEAD.R	W13.Red	🟥	18 AWG	
COIL1.2	SIGNAL_BULKHEAD.4	W12.Orange	🟧	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
FAN_COOL.1	12V	W15.Red	🟥	18 AWG	
FAN_COOL.2	SIGNAL_BULKHEAD.35	W105.Orange	🟧	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
SHIFT.1	12V	W71.Red	🟥	18 AWG	
SHIFT.2	SIGNAL_BULKHEAD.16	W72.Blue	🟦	22 AWG	
SHIFT.3	SIGNAL_BULKHEAD.17	W83.Orange	🟧	22 AWG	
SHIFT.4	SIGNAL_BULKHEAD.18	W111.Brown	🟫	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
COIL2.1	POWER_BULKHEAD.X	W10.Red	🟥	18 AWG	
COIL2.2	SIGNAL_BULKHEAD.5	W14.Orange	🟧	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
CAM_SENSOR.1	POWER_BULKHEAD.K	W79.Red	🟥	22 AWG	
CAM_SENSOR.2	GND_SPLICE	W94.Black	⬛	22 AWG	
CAM_SENSOR.3	SIGNAL_BULKHEAD.26	W120.Blue	🟦	22 AWG	
CAM_SENSOR.4	XDR_GND_SPLICE	W84.Gray	▨	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
INJECTOR_1.1	POWER_BULKHEAD.V	W39.Red	🟥	18 AWG	
INJECTOR_1.2	SIGNAL_BULKHEAD.12	W40.Blue	🟦	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
COOLANT_TEMP.1	SIGNAL_BULKHEAD.28	W26.Blue	🟦	22 AWG	
COOLANT_TEMP.2	XDR_GND_SPLICE	W27.Gray	▨	22 AWG	
FUEL_PRESSURE1_RAIL.1	5V	W53.Red	🟥	22 AWG	
FUEL_PRESSURE1_RAIL.2	SIGNAL_BULKHEAD.39	W48.Blue	🟦	22 AWG	
FUEL_PRESSURE1_RAIL.3	XDR_GND_SPLICE	W54.Gray	▨	22 AWG	
RUNNER1_MAP.1	5V	W16.Red	🟥	22 AWG	
RUNNER1_MAP.2	SIGNAL_BULKHEAD.6	W17.Blue	🟦	22 AWG	
RUNNER1_MAP.3	SIGNAL_BULKHEAD.7	W18.Orange	🟧	22 AWG	
RUNNER1_MAP.4	XDR_GND_SPLICE	W19.Gray	▨	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
GEAR_POSITION.1	CONTROL_BOARD.A	W46.Pink	▧	22 AWG	
GEAR_POSITION.2	CONTROL_BOARD.B	W47.Violet	🟪	22 AWG	
GEAR_POSITION.3	CONTROL_BOARD.C	W50.White	⬜	22 AWG	
GEAR_POSITION.4	CONTROL_BOARD.D	W51.Gray	▨	22 AWG	
GEAR_POSITION.5	CONTROL_BOARD.E	W49.Orange	🟧	22 AWG	
GEAR_POSITION.6	CONTROL_BOARD.F	W45.Red	🟥	22 AWG	
GEAR_POSITION.7	CONTROL_BOARD.G	W52.Yellow	🟨	22 AWG	

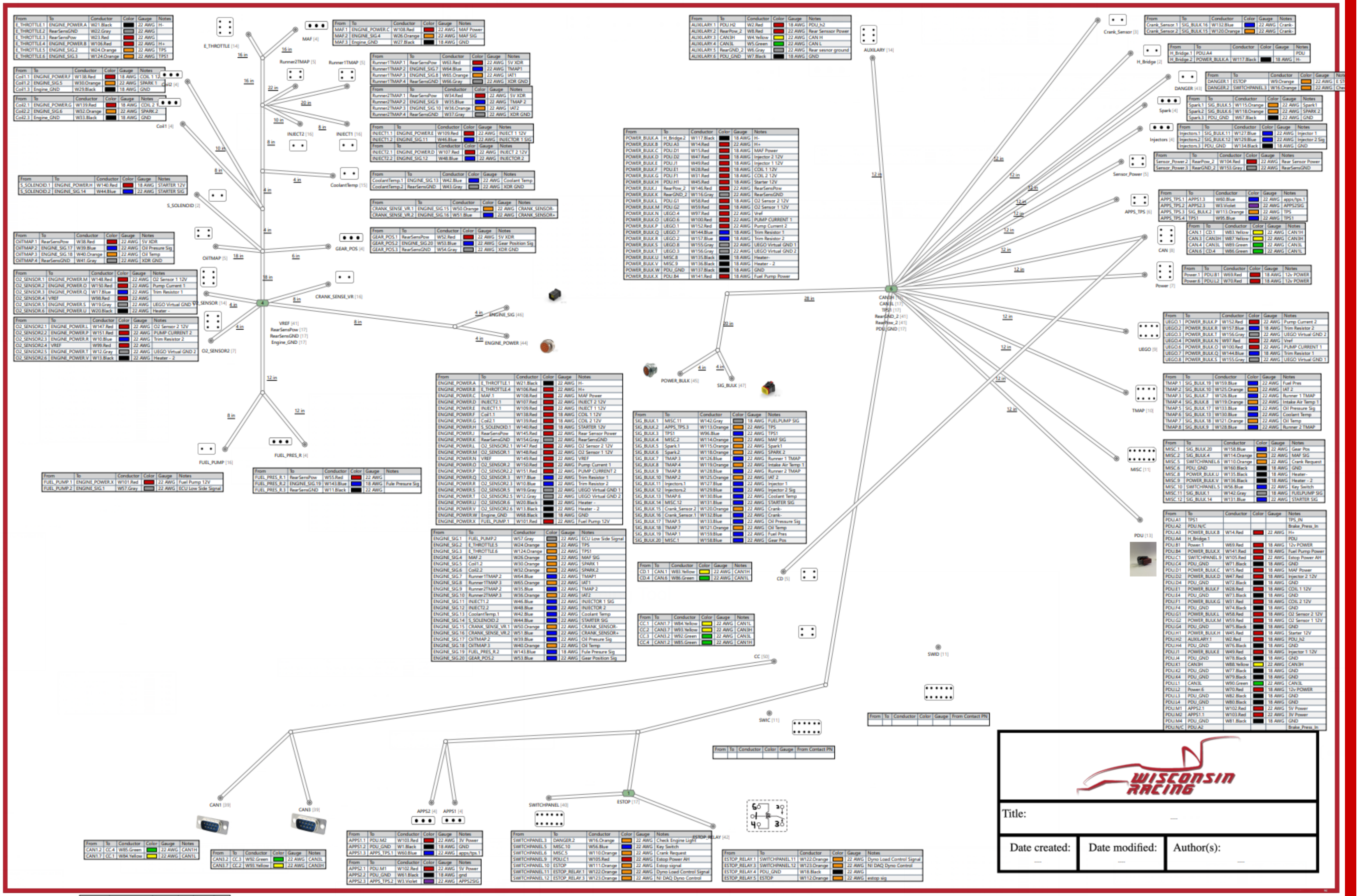
From	To	Conductor	Color	Gauge	From Contact PN
Air_tank_pressure.1	12V	W73.Red	🟥	18 AWG	
Air_tank_pressure.2	SIGNAL_BULKHEAD.40	W112.Orange	🟧	22 AWG	
Air_tank_pressure.3	GND_SPLICE	W87.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge
SHOCKPOT_RL.1	5V	W58.Red	🟥	22 AWG
SHOCKPOT_RL.2	SIGNAL_BULKHEAD.11	W59.Orange	🟧	22 AWG
SHOCKPOT_RL.3	XDR_GND_SPLICE	W60.Gray	▨	22 AWG

From	To	Conductor	Color	Gauge	From Contact PN
TIRE_TEMP_RL.1	12V	W61.Red	🟥	18 AWG	
TIRE_TEMP_RL.2	5V	W62.Red	🟥	22 AWG	
TIRE_TEMP_RL.3	CANH	W63.Yellow	🟨	22 AWG	
TIRE_TEMP_RL.4	CANL	W64.Green	🟩	22 AWG	
TIRE_TEMP_RL.5	XDR_GND_SPLICE	W65.Gray	▨	22 AWG	
TIRE_TEMP_RL.6	GND_SPLICE	W66.Black	⬛	18 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
BRAKE_LIGHT.2	SIGNAL_BULKHEAD.36	W106.Blue	🟦	22 AWG	

From	To	Conductor	Color	Gauge	From Contact PN
WHEEL_SPEED_RL.1	12V	W55.Red	🟥	18 AWG	
WHEEL_SPEED_RL.2	CONTROL_BOARD.K	W56.Blue	🟦	22 AWG	
WHEEL_SPEED_RL.3	GND_SPLICE	W57.Black	⬛	18 AWG	



From	To	Conductor	Color	Gauge	Notes
E_THROTTLE.1	ENGINE_POWER.A	W21.Black	⬛	22 AWG	H-
E_THROTTLE.2	RearSensGND	W22.Gray	▨	22 AWG	
E_THROTTLE.3	RearSensPow	W23.Red	🟥	22 AWG	
E_THROTTLE.4	ENGINE_POWER.B	W106.Red	🟥	22 AWG	H+
E_THROTTLE.5	ENGINE_SIG.2	W24.Orange	🟧	22 AWG	TPS
E_THROTTLE.6	ENGINE_SIG.3	W124.Orange	🟧	22 AWG	TPS1

From	To	Conductor	Color	Gauge	Notes
Coil1.1	ENGINE_POWER.F	W138.Red	🟥	18 AWG	COIL 1 12
Coil1.2	ENGINE_SIG.5	W30.Orange	🟧	22 AWG	SPARK 1
Coil1.3	Engine_GND	W29.Black	⬛	18 AWG	GND

From	To	Conductor	Color	Gauge	Notes
Coil2.1	ENGINE_POWER.G	W139.Red	🟥	18 AWG	COIL 2 1
Coil2.2	ENGINE_SIG.6	W32.Orange	🟧	22 AWG	SPARK 2
Coil2.3	Engine_GND	W33.Black	⬛	18 AWG	GND

From	To	Conductor	Color	Gauge	Notes
MAF.1	ENGINE_POWER.C	W108.Red	🟥	22 AWG	MAF Power
MAF.2	ENGINE_SIG.4	W26.Orange	🟧	22 AWG	MAF SIG
MAF.3	Engine_GND	W27.Black	⬛	18 AWG	GND

From	To	Conductor	Color	Gauge	Notes
Runner1TMAP.1	RearSensPow	W63.Red	🟥	22 AWG	5V XDR
Runner1TMAP.2	ENGINE_SIG.7	W64.Blue	🟦	22 AWG	TMAP1
Runner1TMAP.3	ENGINE_SIG.8	W65.Orange	🟧	22 AWG	IAT1
Runner1TMAP.4	RearSensGND	W66.Gray	▨	22 AWG	XDR GND

From	To	Conductor	Color	Gauge	Notes
Runner2TMAP.1	RearSensPow	W34.Red	🟥	22 AWG	5V XDR
Runner2TMAP.2	ENGINE_SIG.9	W35.Blue	🟦	22 AWG	TMAP 2
Runner2TMAP.3	ENGINE_SIG.10	W36.Orange	🟧	22 AWG	IAT2
Runner2TMAP.4	RearSensGND	W37.Gray	▨	22 AWG	XDR GND

From	To	Conductor	Color	Gauge	Notes
INJECT1.1	ENGINE_POWER.E	W109.Red	🟥	22 AWG	INJECT 1 12V
INJECT1.2	ENGINE_SIG.11	W46.Blue	🟦	22 AWG	INJECTOR 1 SIG

From	To	Conductor	Color	Gauge	Notes
INJECT2.1	ENGINE_POWER.D	W107.Red	🟥	22 AWG	INJECT 2 12V
INJECT2.2	ENGINE_SIG.12	W48.Blue	🟦	22 AWG	INJECTOR 2

From	To	Conductor	Color	Gauge	Notes
S_SOLENOID.1	ENGINE_POWER.H	W140.Red	🟥	18 AWG	STARTER 12V
S_SOLENOID.2	ENGINE_SIG.14	W44.Blue	🟦	22 AWG	STARTER SIG

From	To	Conductor	Color	Gauge	Notes
CoolantTemp.1	ENGINE_SIG.13	W42.Blue	🟦	22 AWG	Coolant Temp
CoolantTemp.2	RearSensGND	W43.Gray	▨	22 AWG	XDR GND

From	To	Conductor	Color	Gauge	Notes
CRANK_SENSE_VR.1	ENGINE_SIG.15	W50.Orange	🟧	22 AWG	CRANK_SENSOR-
CRANK_SENSE_VR.2	ENGINE_SIG.16	W51.Blue	🟦	22 AWG	CRANK_SENSOR+

From	To	Conductor	Color	Gauge	Notes
OilTMAP.1	RearSensPow	W38.Red	🟥	22 AWG	5V XDR
OilTMAP.2	ENGINE_SIG.17	W39.Blue	🟦	22 AWG	Oil Presure Sig
OilTMAP.3	ENGINE_SIG.18	W40.Orange	🟧	22 AWG	Oil Temp
OilTMAP.4	RearSensGND	W41.Gray	▨	22 AWG	XDR GND

From	To	Conductor	Color	Gauge	Notes
GEAR_POS.1	RearSensPow	W52.Red	🟥	22 AWG	5V XDR
GEAR_POS.2	ENGINE_SIG.20	W53.Blue	🟦	22 AWG	Gear Position Sig
GEAR_POS.3	RearSensGND	W54.Gray	▨	22 AWG	XDR GND

From	To	Conductor	Color	Gauge	Notes
O2_SENSOR.1	ENGINE_POWER.M	W148.Red	🟥	22 AWG	O2 Sensor 1 12V
O2_SENSOR.2	ENGINE_POWER.O	W150.Red	🟥	22 AWG	Pump Current 1
O2_SENSOR.3	ENGINE_POWER.Q	W17.Blue	🟦	22 AWG	Trim Resistor 1
O2_SENSOR.4	VREF	W98.Red	🟥	22 AWG	
O2_SENSOR.5	ENGINE_POWER.S	W19.Gray	▨	22 AWG	UEGO Virtual GND 1
O2_SENSOR.6	ENGINE_POWER.U	W20.Black	⬛	22 AWG	Heater -

From	To	Conductor	Color	Gauge	Notes
O2_SENSOR2.1	ENGINE_POWER.L	W147.Red	🟥	22 AWG	O2 Sensor 2 12V
O2_SENSOR2.2	ENGINE_POWER.P	W151.Red	🟥	22 AWG	PUMP CURRENT 2
O2_SENSOR2.3	ENGINE_POWER.R	W10.Blue	🟦	22 AWG	Trim Resistor 2
O2_SENSOR2.4	VREF	W99.Red	🟥	22 AWG	
O2_SENSOR2.5	ENGINE_POWER.T	W12.Gray	▨	22 AWG	UEGO Virtual GND 2
O2_SENSOR2.6	ENGINE_POWER.V	W13.Black	⬛	22 AWG	Heater - 2

From	To	Conductor	Color	Gauge	Notes
FUEL_PUMP.1	ENGINE_POWER.X	W101.Red	🟥	22 AWG	Fuel Pump 12V
FUEL_PUMP.2	ENGINE_SIG.1	W57.Gray	▨	22 AWG	ECU Low Side Signal

From	To	Conductor	Color	Gauge	Notes
FUEL_PRES_R.1	RearSensPow	W55.Red	🟥	22 AWG	
FUEL_PRES_R.2	ENGINE_SIG.19	W143.Blue	🟦	18 AWG	Fule Presure Sig
FUEL_PRES_R.3	RearSensGND	W11.Black	⬛	22 AWG	

From	To	Conductor	Color	Gauge	Notes
ENGINE_POWER.A	E_THROTTLE.1	W21.Black	⬛	22 AWG	H-
ENGINE_POWER.B	E_THROTTLE.4	W106.Red	🟥	22 AWG	H+
ENGINE_POWER.C	MAF.1	W108.Red	🟥	22 AWG	MAF Power
ENGINE_POWER.D	INJECT2.1	W107.Red	🟥	22 AWG	INJECT 2 12V
ENGINE_POWER.E	INJECT1.1	W109.Red	🟥	22 AWG	INJECT 1 12V
ENGINE_POWER.F	Coil1.1	W138.Red	🟥	18 AWG	COIL 1 12V
ENGINE_POWER.G	Coil2.1	W139.Red	🟥	18 AWG	COIL 2 12V
ENGINE_POWER.H	S_SOLENOID.1	W140.Red	🟥	18 AWG	STARTER 12V
ENGINE_POWER.J	RearSensPow	W145.Red	🟥	22 AWG	Rear Sensor Power
ENGINE_POWER.K	RearSensGND	W154.Gray	▨	22 AWG	RearSensGND
ENGINE_POWER.L	O2_SENSOR2.1	W147.Red	🟥	22 AWG	O2 Sensor 2 12V
ENGINE_POWER.M	O2_SENSOR.1	W148.Red	🟥	22 AWG	O2 Sensor 1 12V
ENGINE_POWER.N	VREF	W149.Red	🟥	22 AWG	VREF
ENGINE_POWER.O	O2_SENSOR.2	W150.Red	🟥	22 AWG	Pump Current 1
ENGINE_POWER.P	O2_SENSOR2.2	W151.Red	🟥	22 AWG	PUMP CURRENT 2
ENGINE_POWER.Q	O2_SENSOR.3	W17.Blue	🟦	22 AWG	Trim Resistor 1
ENGINE_POWER.R	O2_SENSOR2.3	W10.Blue	🟦	22 AWG	Trim Resistor 2
ENGINE_POWER.S	O2_SENSOR.5	W19.Gray	▨	22 AWG	UEGO Virtual GND 1
ENGINE_POWER.T	O2_SENSOR2.5	W12.Gray	▨	22 AWG	UEGO Virtual GND 2
ENGINE_POWER.U	O2_SENSOR.6	W20.Black	⬛	22 AWG	Heater -
ENGINE_POWER.V	O2_SENSOR2.6	W13.Black	⬛	22 AWG	Heater - 2
ENGINE_POWER.W	Engine_GND	W68.Black	⬛	18 AWG	GND
ENGINE_POWER.X	FUEL_PUMP.1	W101.Red	🟥	22 AWG	Fuel Pump 12V

From	To	Conductor	Color	Gauge	Notes
ENGINE_SIG.1	FUEL_PUMP.2	W57.Gray	▨	22 AWG	ECU Low Side Signal
ENGINE_SIG.2	E_THROTTLE.5	W24.Orange	🟧	22 AWG	TPS
ENGINE_SIG.3	E_THROTTLE.6	W124.Orange	🟧	22 AWG	TPS1
ENGINE_SIG.4	MAF.2	W26.Orange	🟧	22 AWG	MAF SIG
ENGINE_SIG.5	Coil1.2	W30.Orange	🟧	22 AWG	SPARK 1
ENGINE_SIG.6	Coil2.2	W32.Orange	🟧	22 AWG	SPARK 2
ENGINE_SIG.7	Runner1TMAP.2	W64.Blue	🟦	22 AWG	TMAP1
ENGINE_SIG.8	Runner1TMAP.3	W65.Orange	🟧	22 AWG	IAT1
ENGINE_SIG.9	Runner2TMAP.2	W35.Blue	🟦	22 AWG	TMAP 2
ENGINE_SIG.10	Runner2TMAP.3	W36.Orange	🟧	22 AWG	IAT2
ENGINE_SIG.11	INJECT1.2	W46.Blue	🟦	22 AWG	INJECTOR 1 SIG
ENGINE_SIG.12	INJECT2.2	W48.Blue	🟦	22 AWG	INJECTOR 2
ENGINE_SIG.13	CoolantTemp.1	W42.Blue	🟦	22 AWG	Coolant Temp
ENGINE_SIG.14	S_SOLENOID.2	W44.Blue	🟦	22 AWG	STARTER SIG
ENGINE_SIG.15	CRANK_SENSE_VR.1	W50.Orange	🟧	22 AWG	CRANK_SENSOR-
ENGINE_SIG.16	CRANK_SENSE_VR.2	W51.Blue	🟦	22 AWG	CRANK_SENSOR+
ENGINE_SIG.17	OilTMAP.2	W39.Blue	🟦	22 AWG	Oil Presure Sig
ENGINE_SIG.18	OilTMAP.3	W40.Orange	🟧	22 AWG	Oil Temp
ENGINE_SIG.19	FUEL_PRES_R.2	W143.Blue	🟦	18 AWG	Fule Presure Sig
ENGINE_SIG.20	GEAR_POS.2	W53.Blue	🟦	22 AWG	Gear Position Sig

From	To	Conductor	Color	Gauge	Notes
AUXILARY.1	PDU.H2	W2.Red	🟥	18 AWG	PDU_h2
AUXILARY.2	RearPow_2	W8.Red	🟥	22 AWG	Rear Sensor Power
AUXILARY.3	CAN3H	W4.Yellow	🟨	22 AWG	CAN H
AUXILARY.4	CAN3L	W5.Green	🟩	22 AWG	CAN L
AUXILARY.5	RearGND_2	W6.Gray	▨	22 AWG	Rear sesnor ground
AUXILARY.6	PDU_GND	W7.Black	⬛	18 AWG	GND

From	To	Conductor	Color	Gauge	Notes
POWER_BULK.A	H_Bridge.2	W117.Black	⬛	18 AWG	H-
POWER_BULK.B	PDU.A3	W14.Red	🟥	22 AWG	H+
POWER_BULK.C	PDU.D1	W15.Red	🟥	18 AWG	MAF Power
POWER_BULK.D	PDU.D2	W47.Red	🟥	18 AWG	Injector 2 12V
POWER_BULK.E	PDU.J1	W49.Red	🟥	18 AWG	Injector 1 12V
POWER_BULK.F	PDU.E1	W28.Red	🟥	18 AWG	COIL 1 12V
POWER_BULK.G	PDU.F1	W31.Red	🟥	18 AWG	COIL 2 12V
POWER_BULK.H	PDU.H1	W45.Red	🟥	18 AWG	Starter 12V
POWER_BULK.J	RearPow_2	W146.Red	🟥	22 AWG	RearSensPow
POWER_BULK.K	RearGND_2	W116.Gray	▨	22 AWG	RearSensGND
POWER_BULK.L	PDU.G1	W58.Red	🟥	18 AWG	O2 Sensor 2 12V
POWER_BULK.M	PDU.G2	W59.Red	🟥	18 AWG	O2 Sensor 1 12V
POWER_BULK.N	UEGO.4	W97.Red	🟥	22 AWG	Vref
POWER_BULK.O	UEGO.6	W100.Red	🟥	22 AWG	PUMP CURRENT 1
POWER_BULK.P	UEGO.1	W152.Red	🟥	22 AWG	Pump Current 2
POWER_BULK.Q	UEGO.7	W144.Blue	🟦	18 AWG	Trim Resistor 1
POWER_BULK.R	UEGO.2	W157.Blue	🟦	18 AWG	Trim Resistor 2
POWER_BULK.S	UEGO.8	W155.Gray	▨	22 AWG	UEGO Virtual GND 1
POWER_BULK.T	UEGO.3	W156.Gray	▨	22 AWG	UEGO Virtual GND 2
POWER_BULK.U	MISC.8	W135.Black	⬛	18 AWG	Heater-
POWER_BULK.V	MISC.9	W136.Black	⬛	18 AWG	Heater - 2
POWER_BULK.W	PDU_GND	W137.Black	⬛	18 AWG	GND
POWER_BULK.X	PDU.B4	W141.Red	🟥	18 AWG	Fuel Pump Power

From	To	Conductor	Color	Gauge	Notes
SIG_BULK.1	MISC.11	W142.Gray	▨	18 AWG	FUELPUMP SIG
SIG_BULK.2	APPS_TPS.3	W113.Orange	🟧	22 AWG	TPS
SIG_BULK.3	TPS1	W96.Blue	🟦	22 AWG	TPS1
SIG_BULK.4	MISC.2	W114.Orange	🟧	22 AWG	MAF SIG
SIG_BULK.5	Spark.1	W115.Orange	🟧	22 AWG	Spark1
SIG_BULK.6	Spark.2	W118.Orange	🟧	22 AWG	SPARK 2
SIG_BULK.7	TMAP.3	W126.Blue	🟦	22 AWG	Runner 1 TMAP
SIG_BULK.8	TMAP.4	W119.Orange	🟧	22 AWG	Intake Air Temp 1
SIG_BULK.9	TMAP.8	W128.Blue	🟦	22 AWG	Runner 2 TMAP
SIG_BULK.10	TMAP.2	W125.Orange	🟧	22 AWG	IAT 2
SIG_BULK.11	Injectors.1	W127.Blue	🟦	22 AWG	Injector 1
SIG_BULK.12	Injectors.2	W129.Blue	🟦	22 AWG	Injector 2 Sig
SIG_BULK.13	TMAP.6	W130.Blue	🟦	22 AWG	Coolant Temp
SIG_BULK.14	MISC.12	W131.Blue	🟦	22 AWG	STARTER SIG
SIG_BULK.15	Crank_Sensor.2	W120.Orange	🟧	22 AWG	Crank-
SIG_BULK.16	Crank_Sensor.1	W132.Blue	🟦	22 AWG	Crank-
SIG_BULK.17	TMAP.5	W133.Blue	🟦	22 AWG	Oil Pressure Sig
SIG_BULK.18	TMAP.7	W121.Orange	🟧	22 AWG	Oil Temp
SIG_BULK.19	TMAP.1	W159.Blue	🟦	22 AWG	Fuel Pres
SIG_BULK.20	MISC.1	W158.Blue	🟦	22 AWG	Gear Pos

From	To	Conductor	Color	Gauge	Notes
CD.1	CAN.1	W83.Yellow	🟨	22 AWG	CAN1H
CD.4	CAN.6	W86.Green	🟩	22 AWG	CAN1L

From	To	Conductor	Color	Gauge	Notes
CC.1	CAN1.7	W84.Yellow	🟨	22 AWG	CAN1L
CC.2	CAN3.7	W93.Yellow	🟨	22 AWG	CAN3H
CC.3	CAN3.2	W92.Green	🟩	22 AWG	CAN3L
CC.4	CAN1.2	W85.Green	🟩	22 AWG	CAN1H

From	To	Conductor	Color	Gauge	Notes
Crank_Sensor.1	SIG_BULK.16	W132.Blue	🟦	22 AWG	Crank-
Crank_Sensor.2	SIG_BULK.15	W120.Orange	🟧	22 AWG	Crank-

From	To	Conductor	Color	Gauge	Notes
H_Bridge.1	PDU.A4				PDU
H_Bridge.2	POWER_BULK.A	W117.Black	⬛	18 AWG	H-

From	To	Conductor	Color	Gauge	Not
DANGER.1	ESTOP	W9.Orange	🟧	22 AWG	E ST
DANGER.2	SWITCHPANEL.3	W16.Orange	🟧	22 AWG	Che

From	To	Conductor	Color	Gauge	Notes
Spark.1	SIG_BULK.5	W115.Orange	🟧	22 AWG	Spark1
Spark.2	SIG_BULK.6	W118.Orange	🟧	22 AWG	SPARK 2
Spark.3	PDU_GND	W67.Black	⬛	22 AWG	GND

From	To	Conductor	Color	Gauge	Notes
Injectors.1	SIG_BULK.11	W127.Blue	🟦	22 AWG	Injector 1
Injectors.2	SIG_BULK.12	W129.Blue	🟦	22 AWG	Injector 2 Sig
Injectors.3	PDU_GND	W134.Black	⬛	18 AWG	GND

From	To	Conductor	Color	Gauge	Notes
Sensor_Power.2	RearPow_2	W104.Red	🟥	22 AWG	Rear Sensor Power
Sensor_Power.3	RearGND_2	W153.Gray	▨	22 AWG	RearSensGND

From	To	Conductor	Color	Gauge	Notes
APPS_TPS.1	APPS1.3	W60.Blue	🟦	22 AWG	apps/tps.1
APPS_TPS.2	APPS2.3	W3.Violet	🟪	22 AWG	APPS2SIG
APPS_TPS.3	SIG_BULK.2	W113.Orange	🟧	22 AWG	TPS
APPS_TPS.4	TPS1	W95.Blue	🟦	22 AWG	TPS1

From	To	Conductor	Color	Gauge	Notes
CAN.1	CD.1	W83.Yellow	🟨	22 AWG	CAN1H
CAN.3	CAN3H	W87.Yellow	🟨	22 AWG	CAN3H
CAN.4	CAN3L	W89.Green	🟩	22 AWG	CAN3L
CAN.6	CD.4	W86.Green	🟩	22 AWG	CAN1L

From	To	Conductor	Color	Gauge	Notes
Power.1	PDU.B1	W69.Red	🟥	18 AWG	12v POWER
Power.6	PDU.L2	W70.Red	🟥	18 AWG	12v POWER

From	To	Conductor	Color	Gauge	Notes
UEGO.1	POWER_BULK.P	W152.Red	🟥	22 AWG	Pump Current 2
UEGO.2	POWER_BULK.R	W157.Blue	🟦	18 AWG	Trim Resistor 2
UEGO.3	POWER_BULK.T	W156.Gray	▨	22 AWG	UEGO Virtual GND 2
UEGO.4	POWER_BULK.N	W97.Red	🟥	22 AWG	Vref
UEGO.6	POWER_BULK.O	W100.Red	🟥	22 AWG	PUMP CURRENT 1
UEGO.7	POWER_BULK.Q	W144.Blue	🟦	18 AWG	Trim Resistor 1
UEGO.8	POWER_BULK.S	W155.Gray	▨	22 AWG	UEGO Virtual GND 1

From	To	Conductor	Color	Gauge	Notes
TMAP.1	SIG_BULK.19	W159.Blue	🟦	22 AWG	Fuel Pres
TMAP.2	SIG_BULK.10	W125.Orange	🟧	22 AWG	IAT 2
TMAP.3	SIG_BULK.7	W126.Blue	🟦	22 AWG	Runner 1 TMAP
TMAP.4	SIG_BULK.8	W119.Orange	🟧	22 AWG	Intake Air Temp 1
TMAP.5	SIG_BULK.17	W133.Blue	🟦	22 AWG	Oil Pressure Sig
TMAP.6	SIG_BULK.13	W130.Blue	🟦	22 AWG	Coolant Temp
TMAP.7	SIG_BULK.18	W121.Orange	🟧	22 AWG	Oil Temp
TMAP.8	SIG_BULK.9	W128.Blue	🟦	22 AWG	Runner 2 TMAP

From	To	Conductor	Color	Gauge	Notes
MISC.1	SIG_BULK.20	W158.Blue	🟦	22 AWG	Gear Pos
MISC.2	SIG_BULK.4	W114.Orange	🟧	22 AWG	MAF SIG
MISC.5	SWITCHPANEL.6	W110.Orange	🟧	22 AWG	Crank Request
MISC.6	PDU_GND	W160.Black	⬛	18 AWG	GND
MISC.8	POWER_BULK.U	W135.Black	⬛	18 AWG	Heater-
MISC.9	POWER_BULK.V	W136.Black	⬛	18 AWG	Heater - 2
MISC.10	SWITCHPANEL.5	W56.Blue	🟦	22 AWG	Key Switch
MISC.11	SIG_BULK.1	W142.Gray	▨	18 AWG	FUELPUMP SIG
MISC.12	SIG_BULK.14	W131.Blue	🟦	22 AWG	STARTER SIG

From	To	Conductor	Color	Gauge	Notes
PDU.A1	TPS1				TPS_IN
PDU.A2	PDU.N/C				Brake_Press_In
PDU.A3	POWER_BULK.B	W14.Red	🟥	22 AWG	H+
PDU.A4	H_Bridge.1				PDU
PDU.B1	Power.1	W69.Red	🟥	18 AWG	12v POWER
PDU.B4	POWER_BULK.X	W141.Red	🟥	18 AWG	Fuel Pump Power
PDU.C1	SWITCHPANEL.9	W105.Red	🟥	22 AWG	Estop Power AH
PDU.C4	PDU_GND	W71.Black	⬛	18 AWG	GND
PDU.D1	POWER_BULK.C	W15.Red	🟥	18 AWG	MAF Power
PDU.D2	POWER_BULK.D	W47.Red	🟥	18 AWG	Injector 2 12V
PDU.D4	PDU_GND	W72.Black	⬛	18 AWG	GND
PDU.E1	POWER_BULK.F	W28.Red	🟥	18 AWG	COIL 1 12V
PDU.E4	PDU_GND	W73.Black	⬛	18 AWG	GND
PDU.F1	POWER_BULK.G	W31.Red	🟥	18 AWG	COIL 2 12V
PDU.F4	PDU_GND	W74.Black	⬛	18 AWG	GND
PDU.G1	POWER_BULK.L	W58.Red	🟥	18 AWG	O2 Sensor 2 12V
PDU.G2	POWER_BULK.M	W59.Red	🟥	18 AWG	O2 Sensor 1 12V
PDU.G4	PDU_GND	W75.Black	⬛	18 AWG	GND
PDU.H1	POWER_BULK.H	W45.Red	🟥	18 AWG	Starter 12V
PDU.H2	AUXILARY.1	W2.Red	🟥	18 AWG	PDU_h2
PDU.H4	PDU_GND	W76.Black	⬛	18 AWG	GND
PDU.J1	POWER_BULK.E	W49.Red	🟥	18 AWG	Injector 1 12V
PDU.J4	PDU_GND	W78.Black	⬛	18 AWG	GND
PDU.K1	CAN3H	W88.Yellow	🟨	22 AWG	CAN3H
PDU.K2	PDU_GND	W77.Black	⬛	18 AWG	GND
PDU.K4	PDU_GND	W79.Black	⬛	18 AWG	GND
PDU.L1	CAN3L	W90.Green	🟩	22 AWG	CAN3L
PDU.L2	Power.6	W70.Red	🟥	18 AWG	12v POWER
PDU.L3	PDU_GND	W82.Black	⬛	18 AWG	GND
PDU.L4	PDU_GND	W80.Black	⬛	18 AWG	GND
PDU.M1	APPS2.1	W102.Red	🟥	22 AWG	5V Power
PDU.M2	APPS1.1	W103.Red	🟥	22 AWG	3V Power
PDU.M4	PDU_GND	W81.Black	⬛	18 AWG	GND
PDU.N/C	PDU.A2				Brake_Press_In

From	To	Conductor	Color	Gauge	From Contact PN

From	To	Conductor	Color	Gauge	From Contact PN

From	To	Conductor	Color	Gauge	Notes
CAN1.2	CC.4	W85.Green	🟩	22 AWG	CAN1H
CAN1.7	CC.1	W84.Yellow	🟨	22 AWG	CAN1L

From	To	Conductor	Color	Gauge	Notes
CAN3.2	CC.3	W92.Green	🟩	22 AWG	CAN3L
CAN3.7	CC.2	W93.Yellow	🟨	22 AWG	CAN3H

From	To	Conductor	Color	Gauge	Notes
APPS1.1	PDU.M2	W103.Red	🟥	22 AWG	3V Power
APPS1.2	PDU_GND	W1.Black	⬛	18 AWG	GND
APPS1.3	APPS_TPS.1	W60.Blue	🟦	22 AWG	apps/tps.1

From	To	Conductor	Color	Gauge	Notes
APPS2.1	PDU.M1	W102.Red	🟥	22 AWG	5V Power
APPS2.2	PDU_GND	W61.Black	⬛	18 AWG	gnd
APPS2.3	APPS_TPS.2	W3.Violet	🟪	22 AWG	APPS2SIG

From	To	Conductor	Color	Gauge	Notes
SWITCHPANEL.3	DANGER.2	W16.Orange	🟧	22 AWG	Check Engine Light
SWITCHPANEL.5	MISC.10	W56.Blue	🟦	22 AWG	Key Switch
SWITCHPANEL.6	MISC.5	W110.Orange	🟧	22 AWG	Crank Request
SWITCHPANEL.9	PDU.C1	W105.Red	🟥	22 AWG	Estop Power AH
SWITCHPANEL.10	ESTOP	W111.Orange	🟧	22 AWG	Estop signal
SWITCHPANEL.11	ESTOP_RELAY.1	W122.Orange	🟧	22 AWG	Dyno Load Control Signal
SWITCHPANEL.12	ESTOP_RELAY.3	W123.Orange	🟧	22 AWG	NI DAQ Dyno Control

From	To	Conductor	Color	Gauge	Notes
ESTOP_RELAY.1	SWITCHPANEL.11	W122.Orange	🟧	22 AWG	Dyno Load Control Signal
ESTOP_RELAY.3	SWITCHPANEL.12	W123.Orange	🟧	22 AWG	NI DAQ Dyno Control
ESTOP_RELAY.4	PDU_GND	W18.Black	⬛	22 AWG	
ESTOP_RELAY.5	ESTOP	W112.Orange	🟧	22 AWG	estop sig

From	To	Conductor	Color	Gauge	Notes

WISCONSIN RACING

Title: —

Date created: —

Date modified: —

Author(s): —

Low Voltage Load Characterization

The team characterized load currents from the 8 fuses using the DynoPDU so the smart circuitry didn’t interfere with our measurements. This information will help us optimize the fuse panel for future iterations.

The loads on each fuse are as follows:

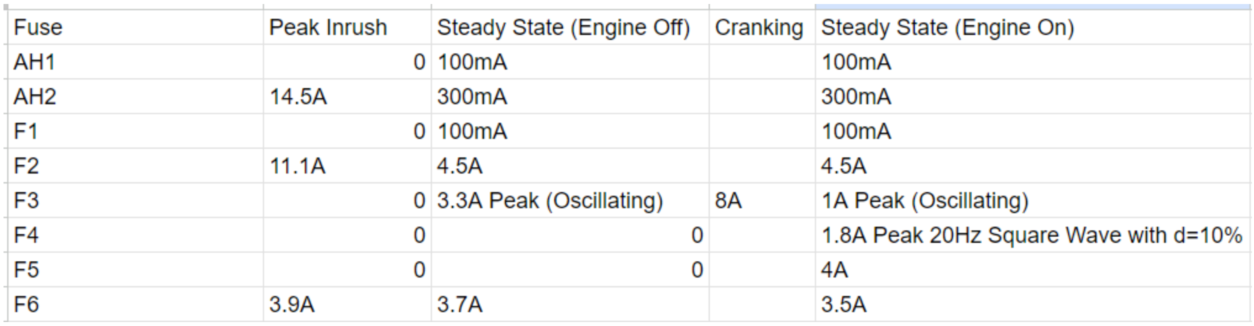
AH 1	**AH 2**	**Fuse 1**	**Fuse 2**	**Fuse 3**	**Fuse 4**	**Fuse 5**	**Fuse 6**
ECU AH	EVO	Front Sensors	Steering Wheel	ECU GLV	Injectors	Oil Pump Solenoid	O2 Heater (2)
MPRD Switch	IMU		Fuel Pump	Shifting	Cooling Fan		

Process

For the testing setup, a current clamp was placed around each fuse output. An oscilloscope trace was taken as GLV was turned on. The test was repeated for each fuse output with the engine off and the engine on. The inrush current peak, steady state for both engine off and engine on was recorded. The cranking current for Fuse 3 was recorded to see how the ECU was affected by it.

Results

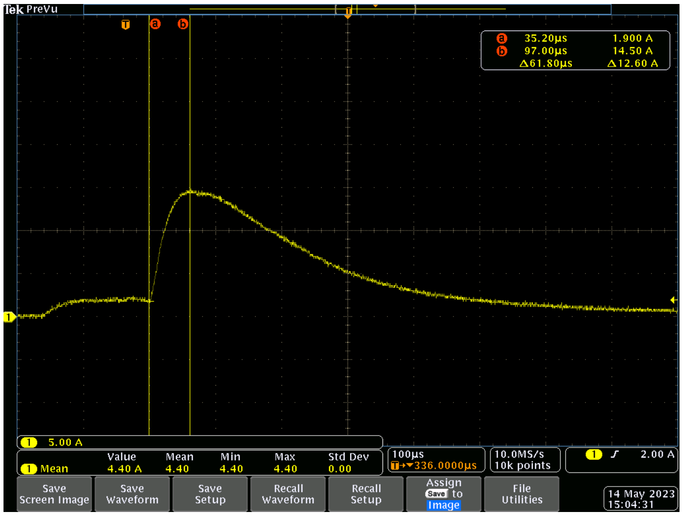
This table records the results we obtained from running this test. Included are snapshots of the oscilloscope traces of results we found particularly interesting.



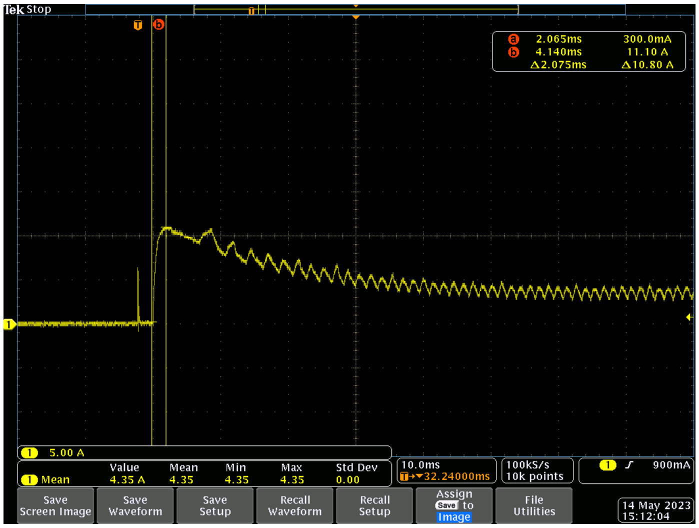
Fuse	Peak Inrush	Steady State (Engine Off)	Cranking	Steady State (Engine On)
AH1	0	100mA		100mA
AH2	14.5A	300mA		300mA
F1	0	100mA		100mA
F2	11.1A	4.5A		4.5A
F3	0	3.3A Peak (Oscillating)	8A	1A Peak (Oscillating)
F4	0	0		1.8A Peak 20Hz Square Wave with d=10%
F5	0	0		4A
F6	3.9A	3.7A		3.5A

Capacitance Equation:

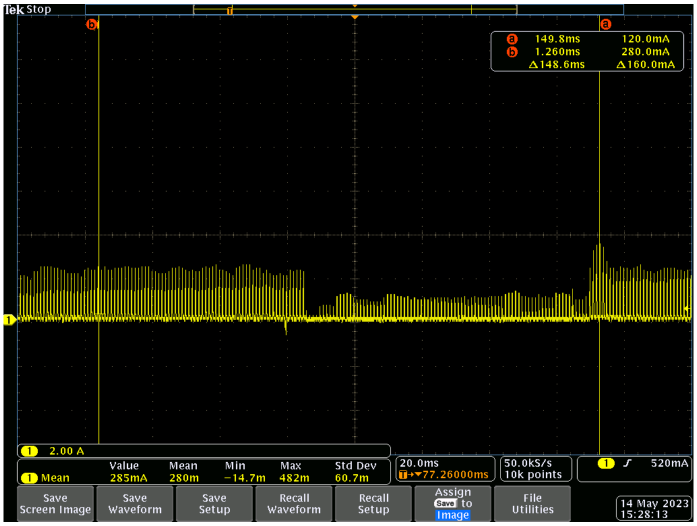
C = int(i dt)/V



Always Hot 2 Inrush (Evo)
Calculated Capacitance: 40uF



Fuse 2 Inrush
Calculated Capacitance: 1.2mF



Fuse 3 ECU Oscillations

It is important to know that this power output pulses like this because it is a source of EMC in our system. To mitigate this, we shielded sensitive signals and routed them away from things powered by the ECU when possible.

Electric Car Designs

Overview

Wisconsin Racing also builds a car for the electric competition. The unique electrical designs for the electric car can be found here: https://www.wisconsinracing.org/e-documents/.

Electric Car Specific Designs

- Battery Management System
    - Battery Main Board - Centralized Low Voltage System
    - Battery Sensor Board - LTC6811 battery management IC
    - Battery Trace Board - Muxing System for cell measurement
    - Battery Management Algorithms and code
- 3 phase Quad Inverter (motor controller)
    - Control Card - Houses motor controller, signal and fault processing
    - Gate Driver - Houses the gate drivers and isolated power supplies to drive the gates of the IGBTs
    - Double Pulse Testing - Validation of the inverter switching efficiency
- Precharge
    - Board to control the ramp up of voltage when initially turning on the high voltage system
- Motor Controls
    - Custom motor controls for a 3 phase synchronous motor.
- High Voltage Daughter Board
    - Senses the high voltage bus and controls the Tractive System Active Light
    - Houses the HV to LV DC DC converter
- Systems Integration

Shared Designs - Only Found in 2023 ECar Design Release

- Smart Power Distribution Unit
- Steering Wheel
- Brake Systems Plausibility Device

Contact Us

To contact the team, email: team@go.uwracing.com

To contact the 2023 Electrical Technical Director with questions related to this document and its designs, email: christian@lastlock.com

Thank you for reading! Good luck from Wisconsin!

WISCONSIN RACING COMBUSTION

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