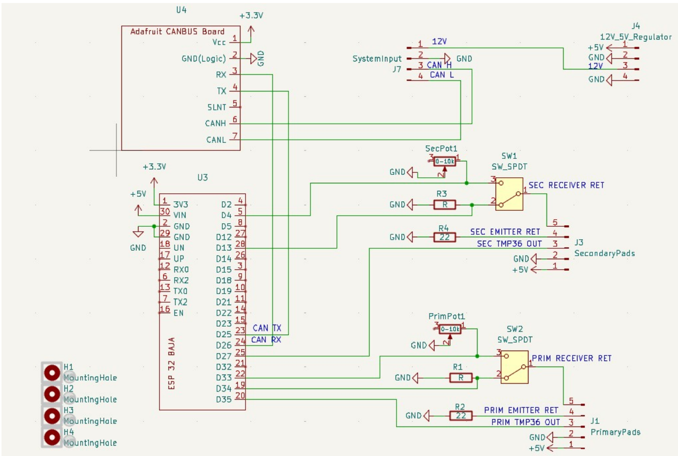
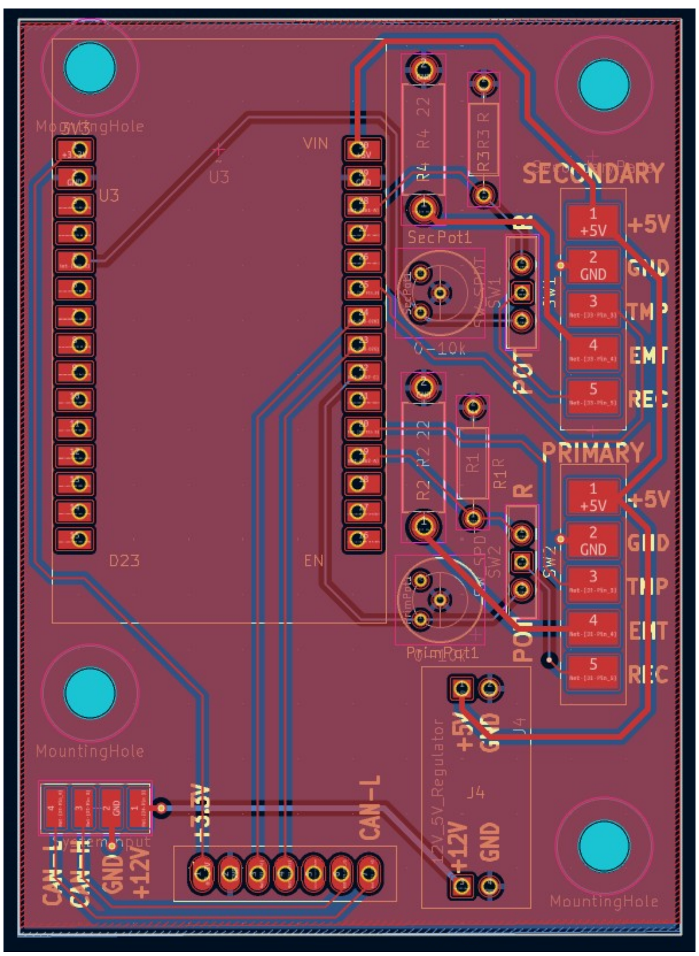
NJIT BAJA Project Descriptions

CVT Tachometer





With this project, I was tasked with converting the perfboard version into a PCB for reliability, and it was also proven to work well during competition.

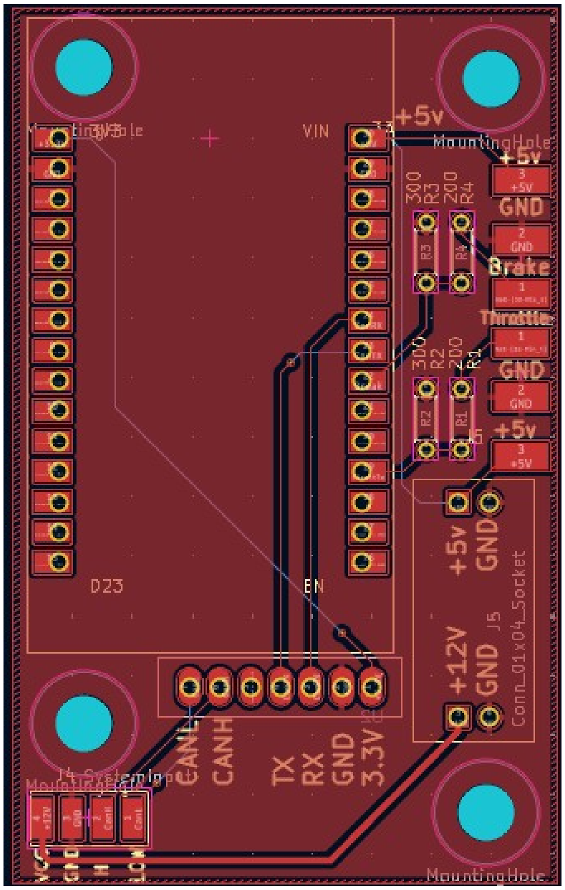
The function of this board is the read the RPMs of both the secondary and primary RPM of the CVT. These numbers were used to find the gear ratio for tuning, RPM gauge to dashboard, and also finding if the wheels are slipping. We were able to display to the driver if they are losing traction with one wheel due to high speed with little or no wheel rotation, or low speed with high wheel RPM. This board also reads the temperature of the CVT belt since it melted during competition in California.

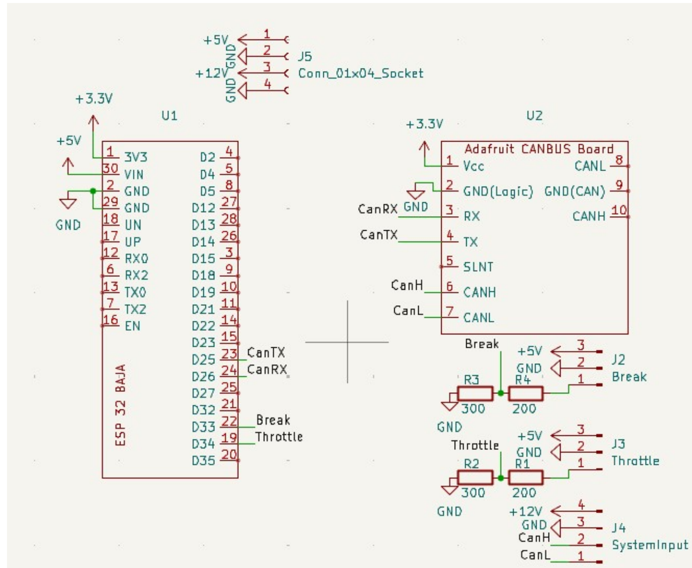
Temperature sensor: TMP36

Speed: Infrared sensors. Checked for pulses of the difference in the time the beam took to return back to receiver.

Pedal Sensors

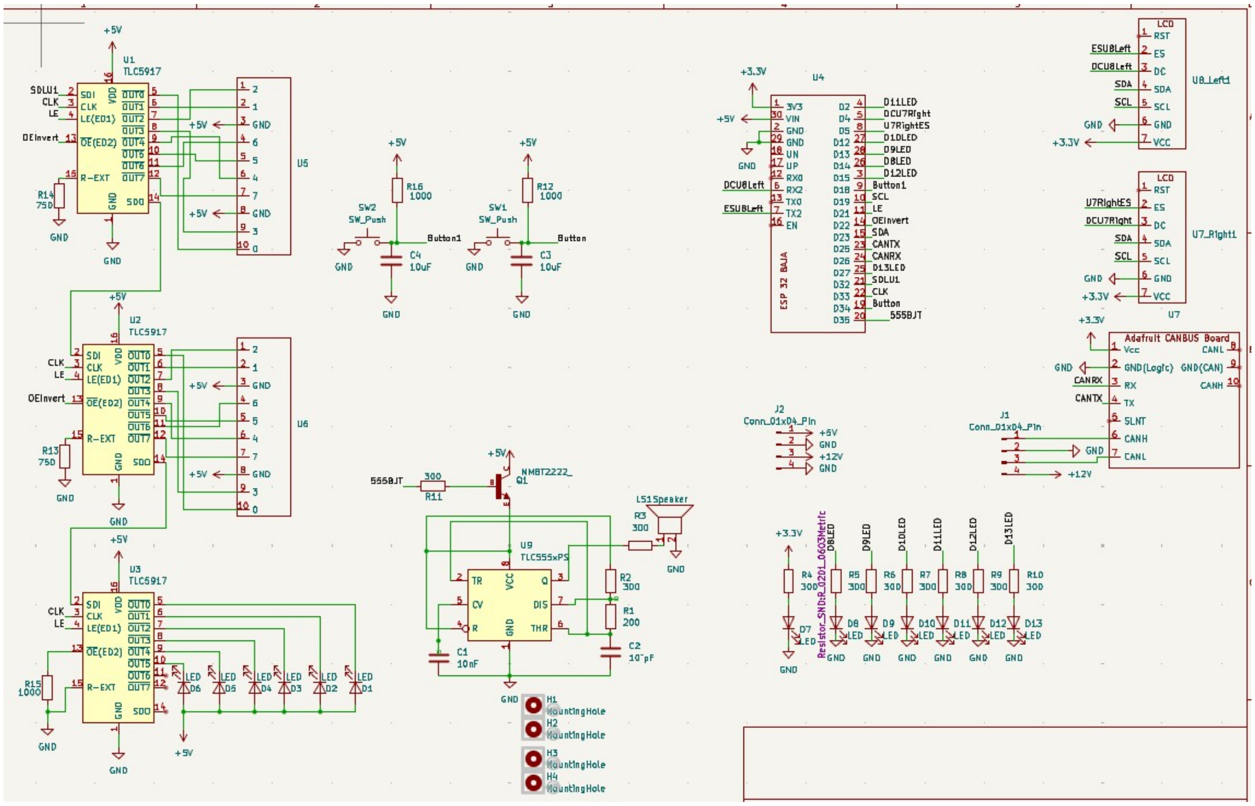
We used PSC360G2-F2AA-C0002-ERA360-05K hall effect sensors. Like the CVT tachometer, I was tasked with converting the protoboard into a PCB.





Dashboard

With the dashboard, I was tasked with making it into a 4 layer PCB, allow the driver to change screen options, add a buzzer for notifying the driver of a critical mechanical failure, error code screen, indication of which tire is skidding or slipping, and brightness control. We used 2 buttons for changing screens. One was used for cycling the screen options. The other button was used for doing an action on that screen such as cycling between cvt temperature, error code information, or changing brightness where a press changes up and down and hold increases/decreases. Error codes include sensor failure, cvt temp, fuel low, etc. The indication of slipping and skidding is similar to the GTR races. ¼ of each screen would light up depending on which tire is skidding or slipping. Red is skid, orange is slip. This would remind the driver to pump the brakes or be more gradual on the gas.



U1
TLC5917
U2
TLC5917
U3
TLC5917
U4
ESP 32 BAJA
U5
U6
U7
U8_Left1
U7_Right1
U9
TLC555xPS
Adafruit CANBUS Board
J1
Conn_01x04_Pin
J2
Conn_01x04_Pin
SW1
SW_Push
SW2
SW_Push
Button
Button1
NMBT2222_
555BJT
LS1Speaker
H1
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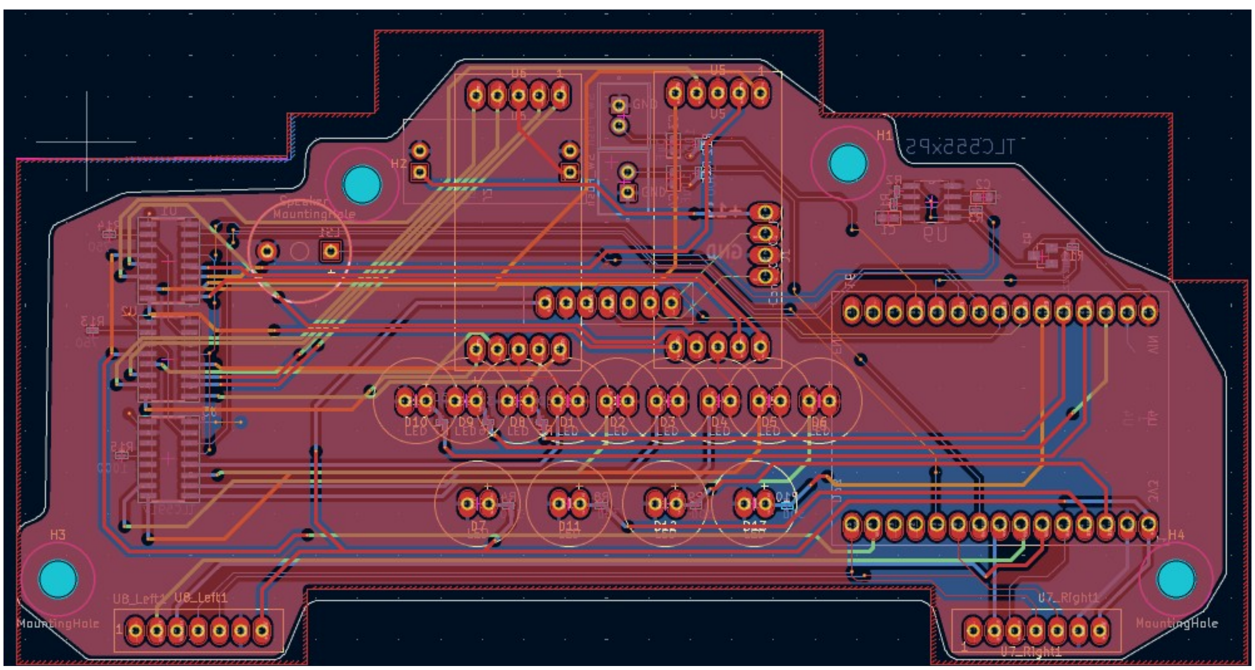
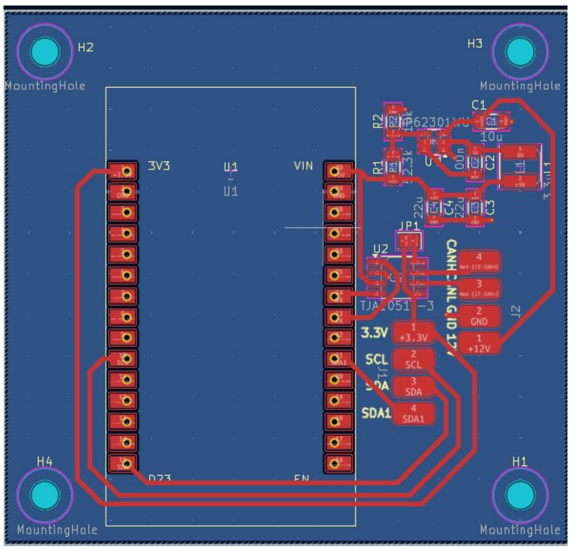
MountingHole
H4
MountingHole

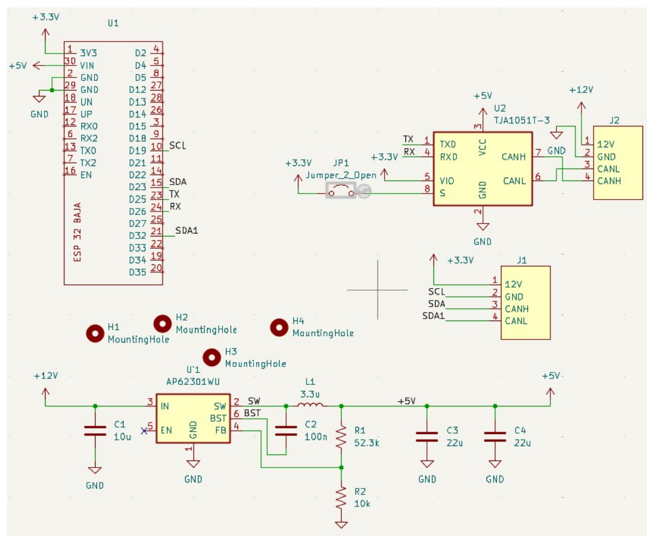


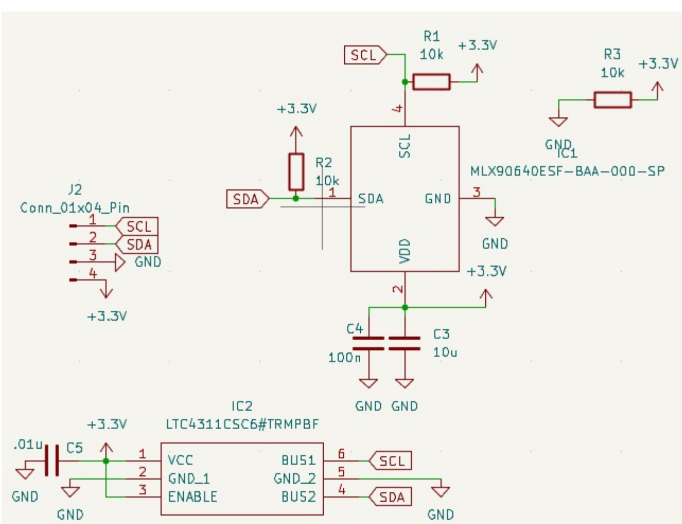

07:31:44
4WD 2WD
CVT
0.0
MPH
FUEL
PWR
CVT
BAT
DAQ
HIGHLANDER
RACING
0
RPM
x100

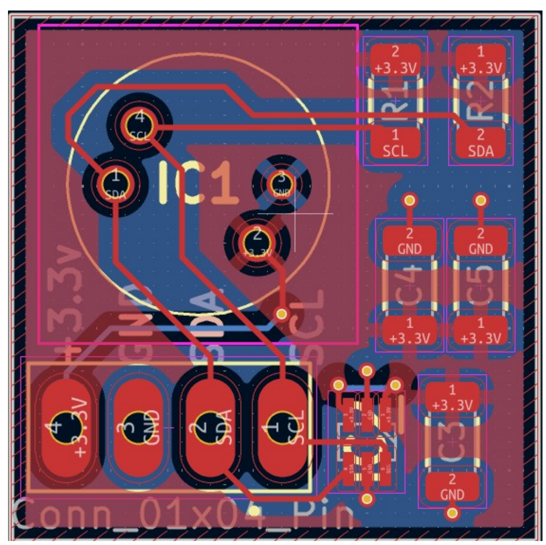
Rotor and CVT Heat map

There was a need to find the heatmap of the brake rotors and cvt belt during testing by the mechanical team. We use a I2C extender due the length of cable from the motherboard to the sensor. For the 2026 year, we switched to an on board buck booster after finding out it worked well during the 2025 year, and also use a CAN bus IC instead of an adafruit module. The sensor had to be small so as to not interfere too much with the mechanical design of the cvt and wheel rotor. The sensor has a 120 degree field of view and a default max temperature reading of 600ºF which is less than what any assembly would reach. It can be recalibrated to higher temperatures. The sensor takes a temperature reading as a 2D array. The motherboard sends the data one integer at a time to the DAQ to store into a csv on its SD card. Once the SD card is removed, using matplot++ it creates a series of images of the heatmap of the cvt and wheel rotor.







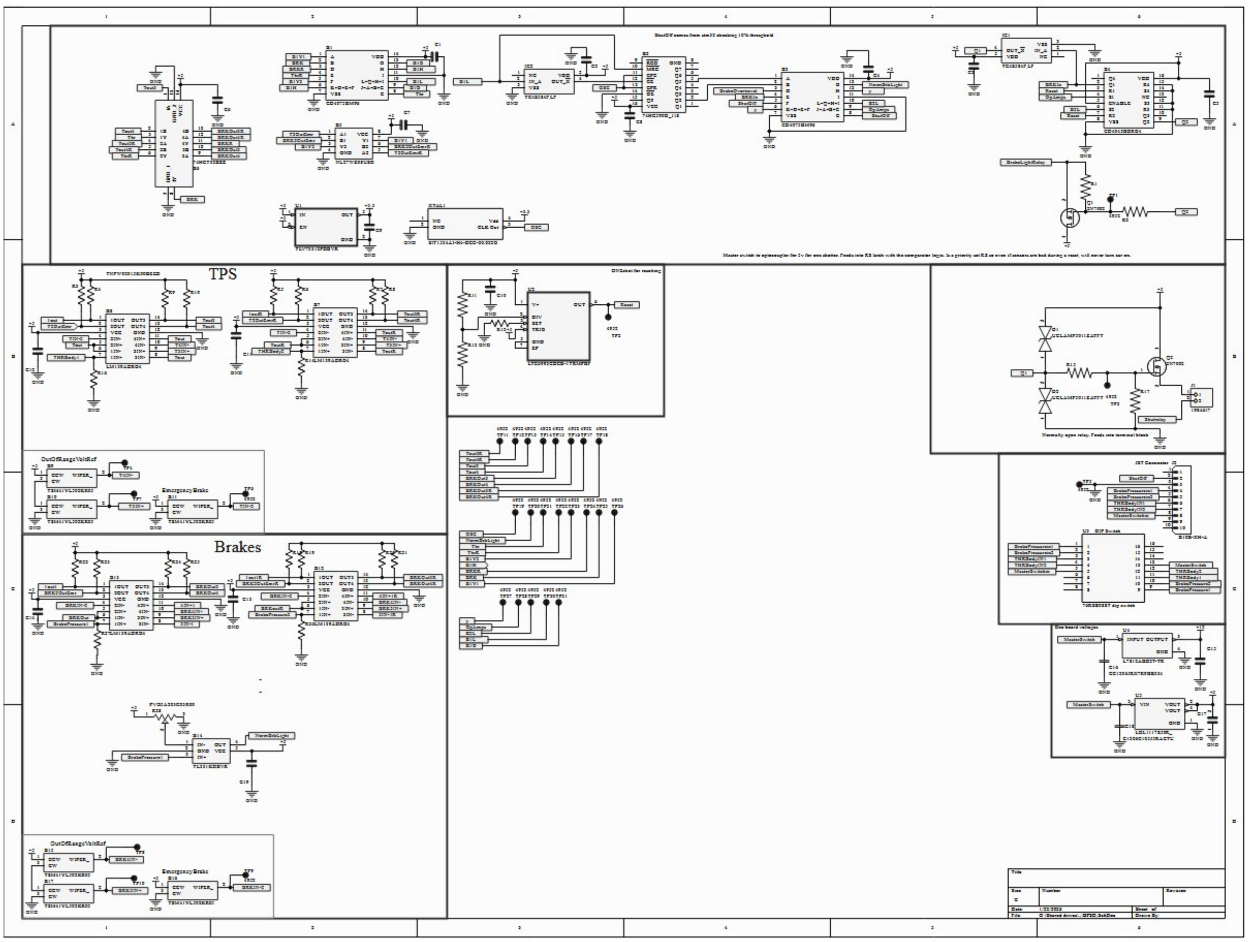


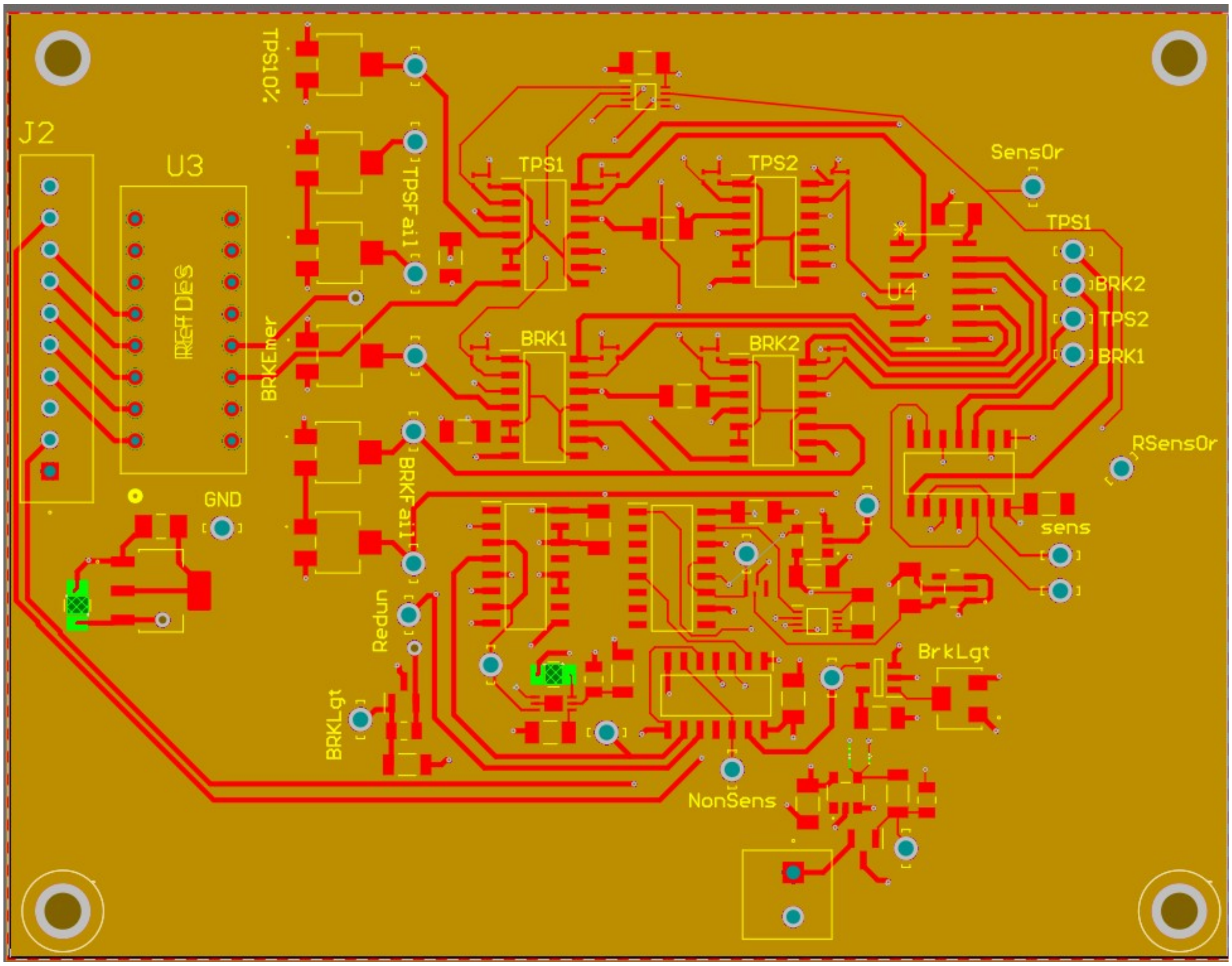
Code for the dashboard and temperature sensor can be found here

FSAE Project Descriptions

BSPD

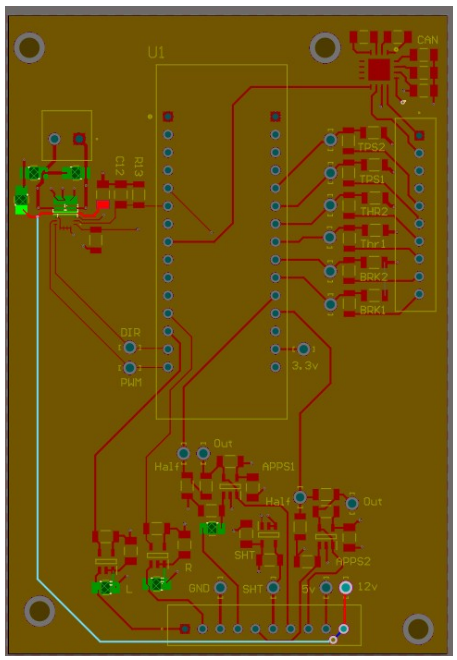
The BSPD is a required circuit to ensure that the TPS and brake pressure sensors are functioning properly. By using window comparators that output high when they detect a short or open circuit with the sensor, it triggers a digital counter. When around 93ms pass, it shuts off the relay to the spark plugs and fuel pump. During an emergency braking condition where the driver is putting the brake pedal to the max and the TPS sensor is more than 10% open and one second has passed, it also shuts off those relays. The BSPD also takes inputs from the brake over travel switch and a STM32 checking if sensors are within 10% of each other. Brake overtravel is hit when the brake pressure lines fail, allowing the pedal to go farther than it could if properly pressurized. The board can only be resetted if the master switch is cycled. A LTC6993 which is used as a one shotter resets the RS latch. This board also controls the brake light. If the brake pedal is pressed or any failure has occurred, the light turns on.

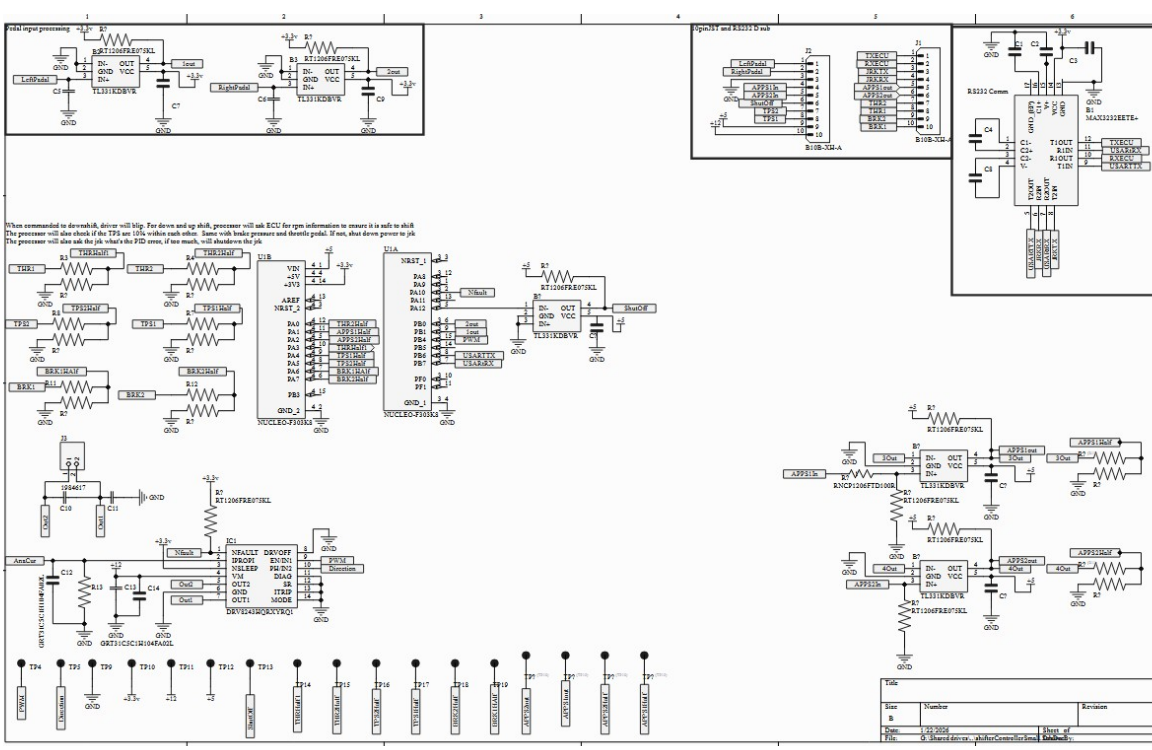



J2
U3
TPS10%
TPSFail
BRKEmer
BRKFail
Redun
BRKLgt
GND
TPS1
TPS2
BRK1
BRK2
U4
SensOr
TPS1
BRK2
TPS2
BRK1
RSensOr
sens
BrkLgt
NonSens

Shifter

The shifter circuit cycles the gear on the Yamaha R6 engine. When commanded to upshift, it checks if the RPM is safe to shift into, cuts spark and fuel, and then shifts. We are using an automotive H-Bridge driver IC with integrated current sense. Once it detects a stall, power to the motor is removed, and the internal return spring brings the knob to neutral position. During the downshift, we are trusting our driver with blipping the throttle. Using RS232 communication with the ECU, the STM32 is able to get RPM data. The controller also checks that sensors are within 10% of each other.





PDFs and code can be found here