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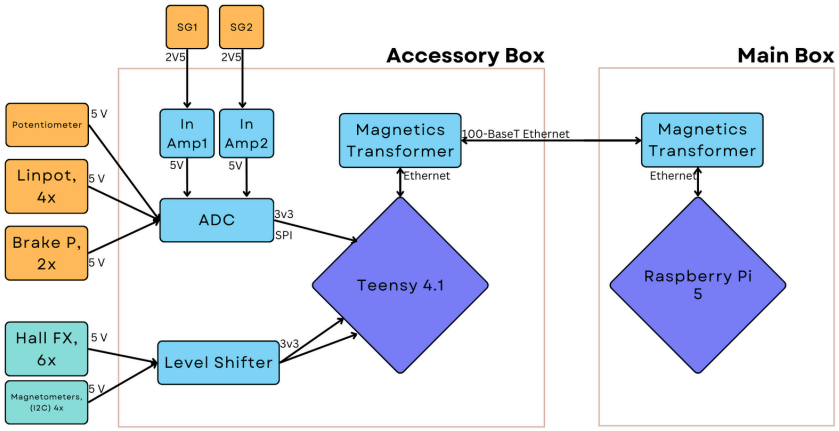
DATA ACQUISITION PCB FOR A/D SENSORS - BLUE JAY RACING

(Revision 1)

Signal Architecture



Purpose

- Design a circuit that reads the strain, speed, pressure, suspension, and distance traveled for an off-road vehicle
- Performed a **needs analysis** to initiate the design process

Revision 1:

- All sensors in black were implemented for the first revision

1 Accessory (DAQ) PCB on car for all sensors

Front

	Digital	Analog	
5V	FL axle Hall (9 mA max)	FL Linpot	5V
	FR axle Hall (9 mA max)	FR Linpot	
	Prop Shaft. Hall (20 kHz)	F Brake Pressure	
	FL Magnetometer (I2C, ~1 kHz)	FL Tie Rod SG (120 Ω, Q Bridge)	2V5
	FR Magnetometer	FR Tie Rod SG	
		Steering Potent.	5V

Rear

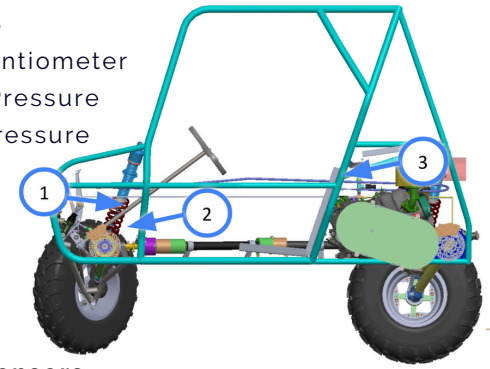
	Digital	Analog	
5V	CVT Primary Hall (Tach) (9 mA max)	RL Linpot	5V
	Brake Rotor Hall (WS) (9 mA max)	RR Linpot	
	Rear Axle Hall (position)	R Brake Pressure	
	RL Magnetometer (I2C)		
	RR Magnetometer		

21XT Vehicle

Sensor Placement

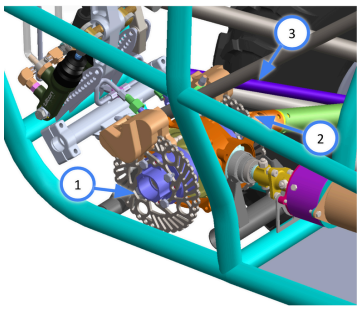
General Sensors

1) Steering Potentiometer
2) Front Brake Pressure
3) Rear Brake Pressure



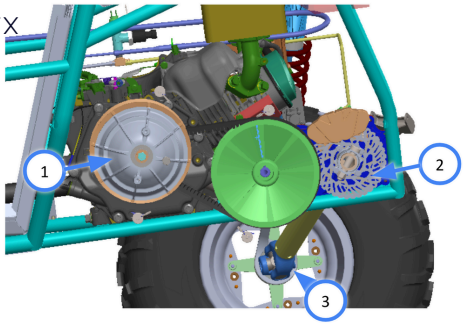
Front Sensors

1) FL Axle Hall Effect
2) FR Axle Hall Effect
3) Tie Rod Strain Gauges (x2)



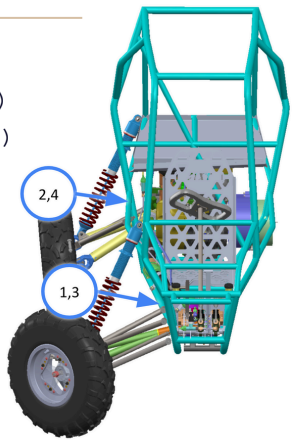
Rear Hall Effect Sensors

1) CVT Primary Tachometer
2) Brake Rotor Hall FX
3) Rear Axle Hall FX



Suspension Sensors

1) FL Magnetometer (x2 for FR)
2) RL Magnetometer (x2 for RR)
3) FL Linear Potentiometer (x2 for FR)
4) RL Linear Potentiometer (x2 for FR)



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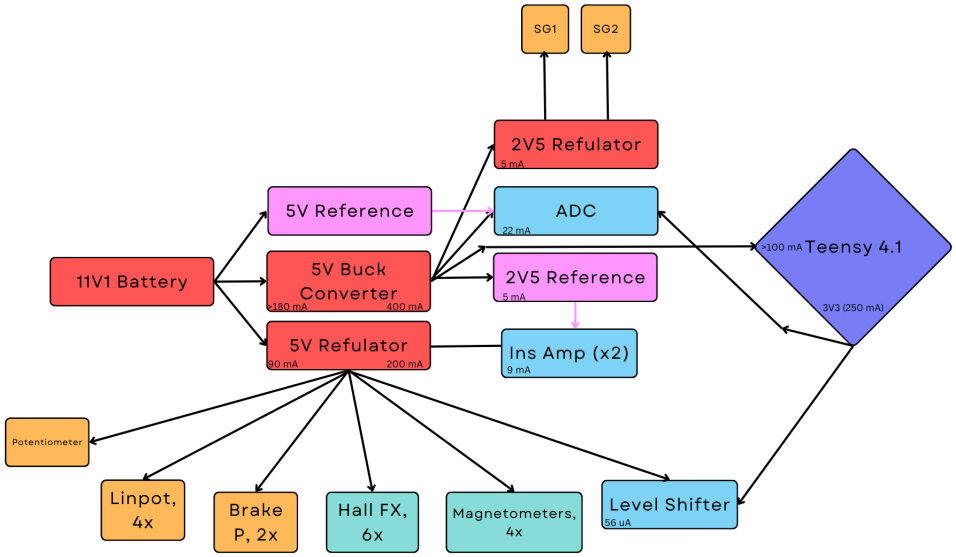
Power Architecture



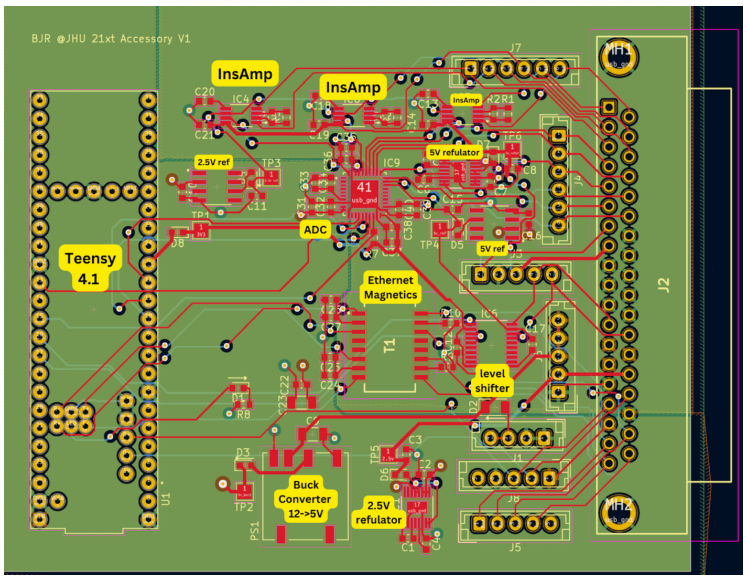
Requirements

- Design a system that is able to support 5V analog and digital sensors, and 2.5V differential analog sensors
- Verify the power sourcing and sinking capabilities of all ICs

Key:

- Analog Sensor
- Digital Sensor
- A,D IC
- Power Source/Conv
- Reference
- MicroDev Board

Schematic & PCB Design



96.5 mm x 79 mm

Design Process

- Used KiCAD to design schematic and PCB
- Implemented Teensy 4.1 Dev. Board for its strong CPU performance & RAM
- Selected DC37 Connector along with testing connectors

Testing Procedure

- Tested for power and ADC signal connectivity
- Confirm buck converter, reference, and regulator stability w/ oscilloscope
- Verified strain gauge linearity, calibrated sensors
- Analyzed Teensy 4.1 Program Output

Results

- Power ICs and ADC operated within expectations
- Ethernet successfully transmitted at 100 Mbps
- Increased sensor capacity by 260% from 20XT
- Teensy 4.1 fully functional
- Reduced PCB size by 15% between Revision 1 & 2
- Implemented a DAC for a variable reference to InAmps