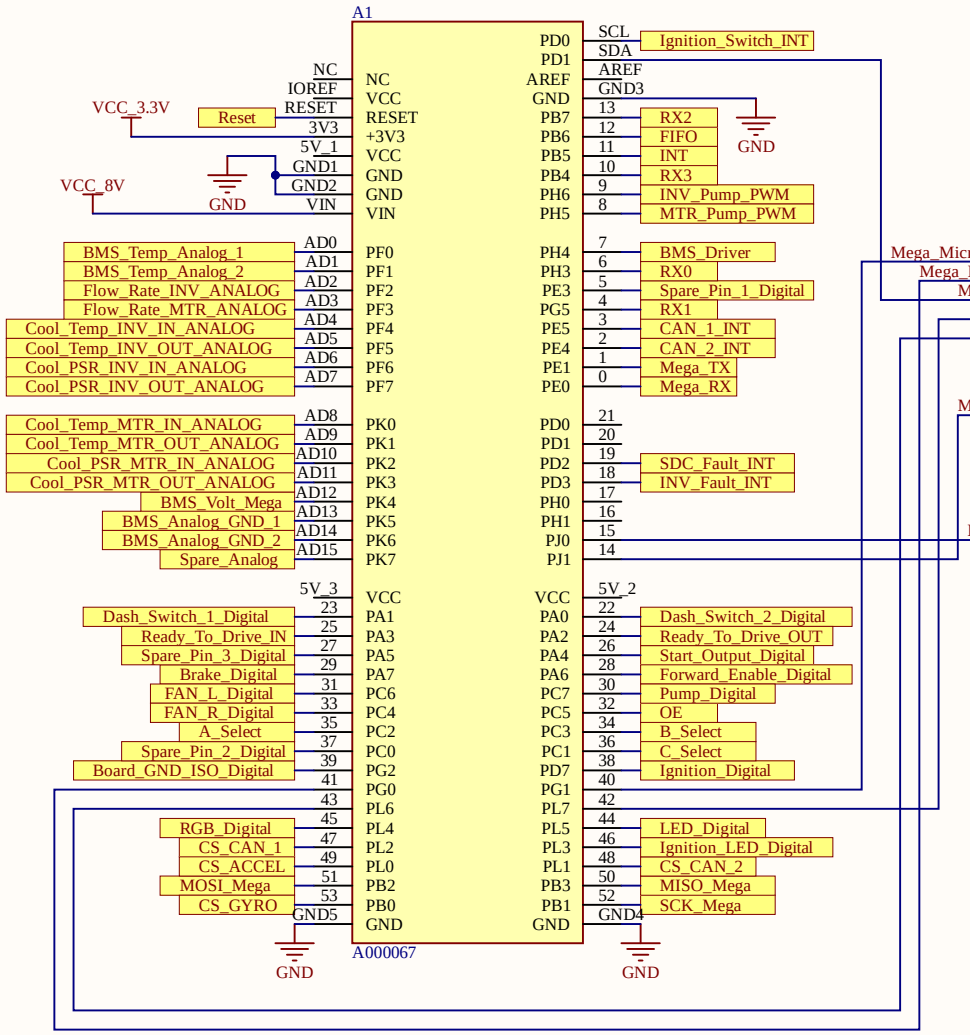
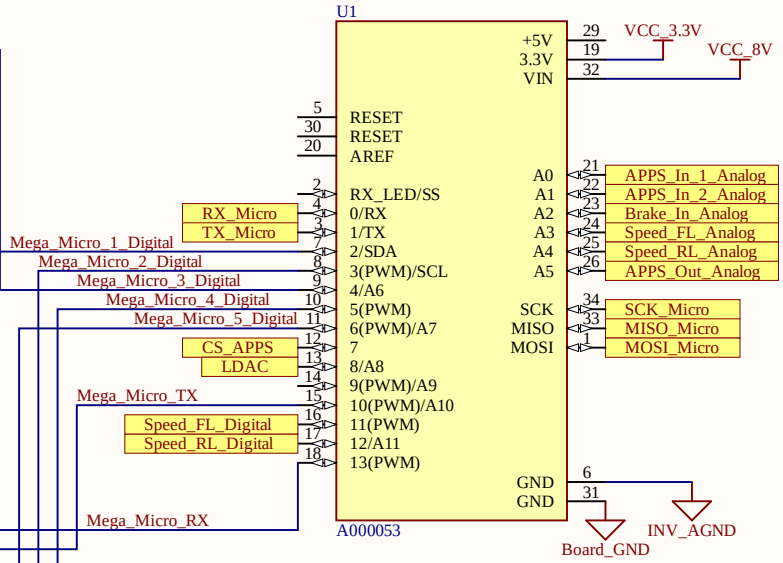
Arduino Mega Shield



Arduino Micro Shield



Schematic

Layout

Calculations

Tall components near mounting points

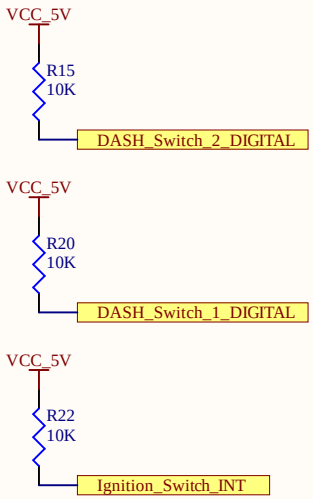
Interrupts: Mega_Micro_1_Digital, Mega_Micro_2_Digital

INV_AGND will be a trace coming from the powertrain connector to clean up the APPS OUT Signal.

Interrupts: Ignition_Switch, SDC_Fault, CAN_1, CAN_2, Mega_Micro_2_Digital, Micro_3_Digital
PCINTs: FIFO, INT

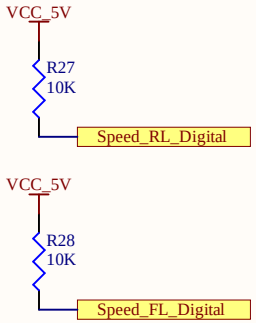
Title	Arduino Shields		
Size	Number		Revision
A4	1		v.3.0
Date:	3-26-2022	Sheet of	10
File:	D:\Benjamin\..\Arduino_Shields.SchDoc	Drawn By:	Benjamin Liang

Switch Pull Up Resistors

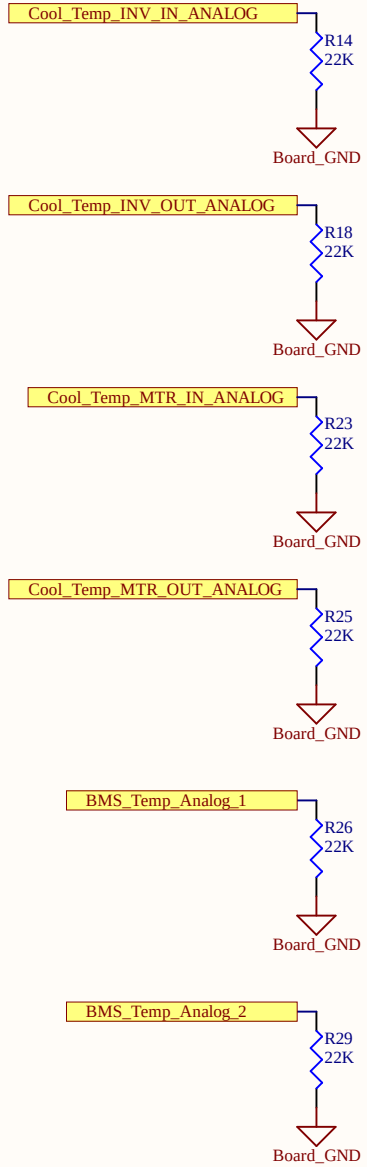


Wheel speed sensor is open collector and switches all switch to ground.

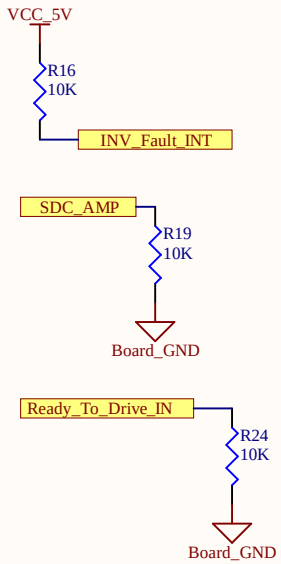
Hall Effect Pull Up Resistors



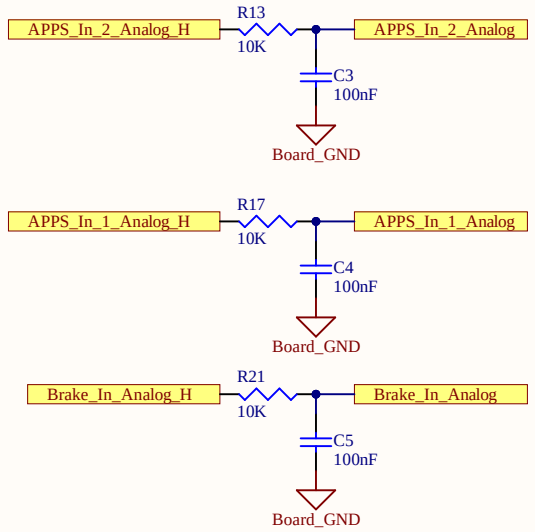
Thermistor Pull Down Resistors



System Critical Pull Up/Down



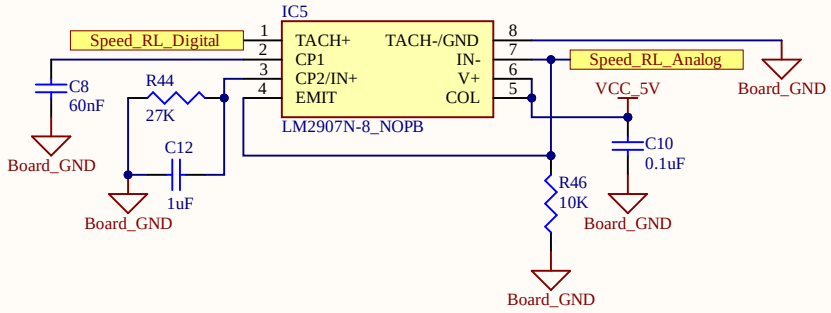
Drive Signal Filters



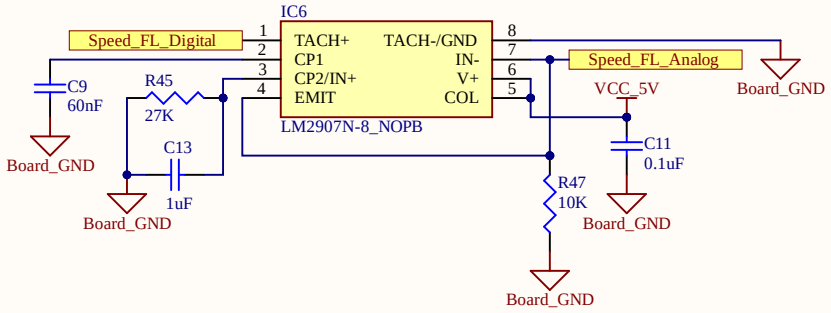
RC filter for drive critical analog inputs, resistor can be substituted with 0Ohm resistor if not needed

Title	Passive Circuits		
Size A4	Number 2		Revision v.3.0
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\Passive_Circuits.SchDoc		Drawn By: Benjamin Liang	

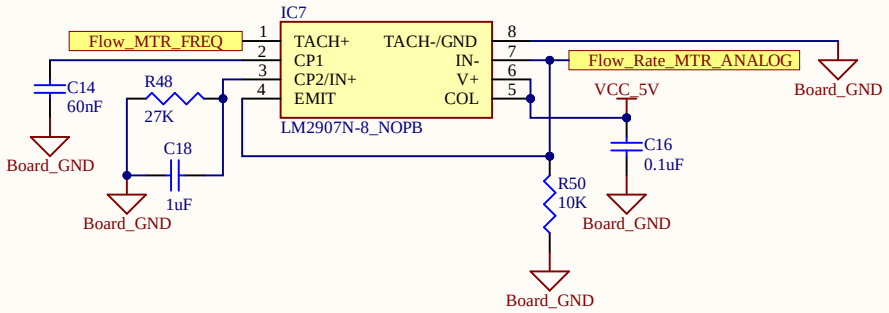
Wheel Speed RL



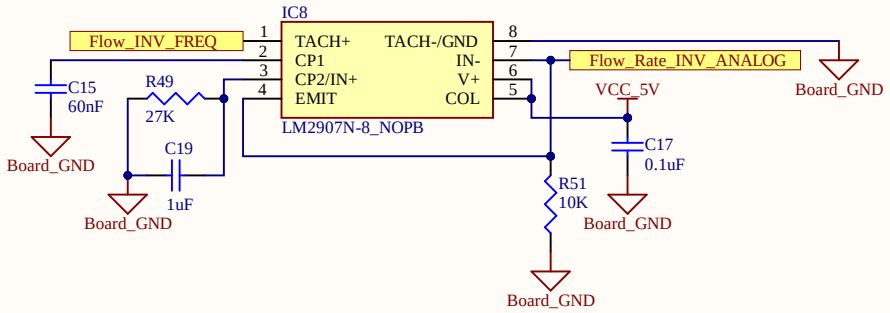
Wheel Speed FL



Flowrate MTR



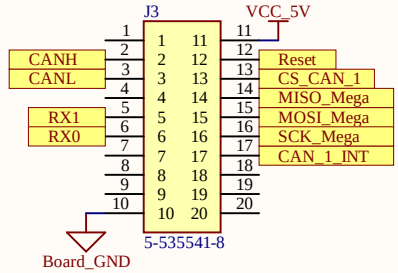
Flowrate INV



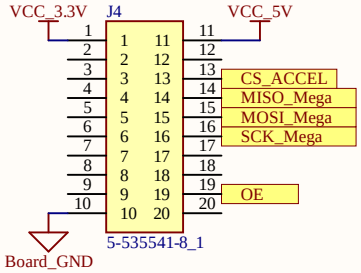
Max frequency is 452Hz with max speed of 130kph, 18" wheels and 18Hz per cycle. 600Hz with FOS which requires a 60nF capacitor.

Title	Frequency to Analog	
Size: A4	Number: 3	Revision: v.3.0
Date: 3-26-2022	Sheet of 10	
File: D:\Benjamin\..\Frequency_Analog.SchDoc	Drawn By: Benjamin Liang	

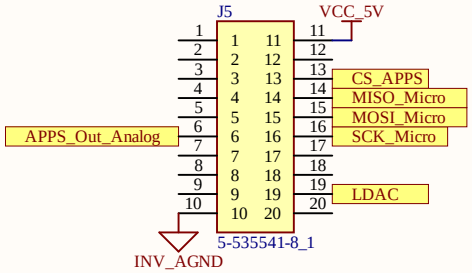
CAN Module 1



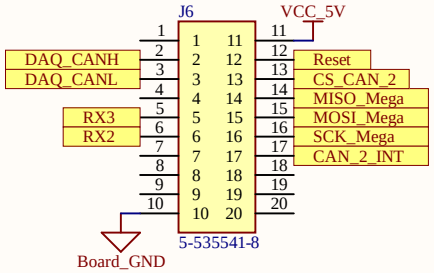
Accelerometer



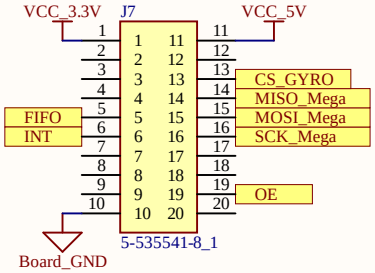
APPS OUT



CAN Module 2



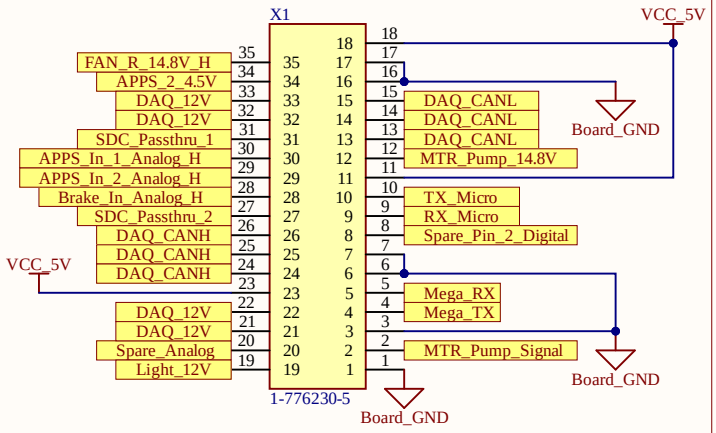
Gyroscope



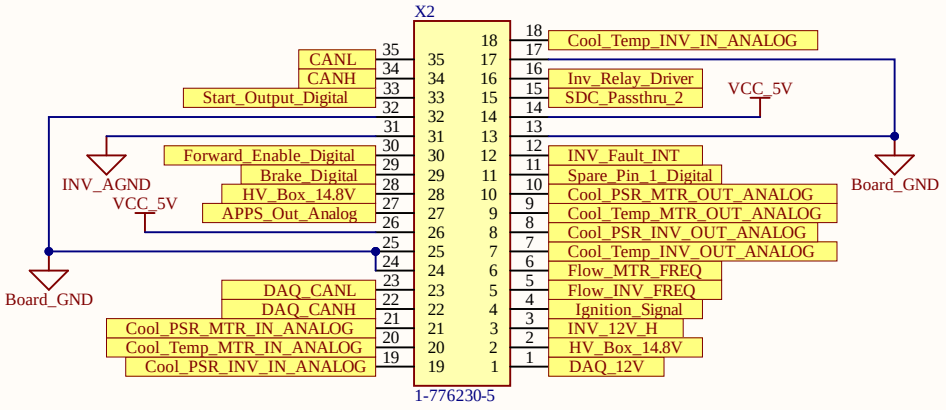
CANL and CANH traces should be similar length

Title	SPI Breakout Modules		
Size: A4	Number: 4	Revision: v.3.0	
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\SPI_Breakout.SchDoc		Drawn By: Benjamin Liang	

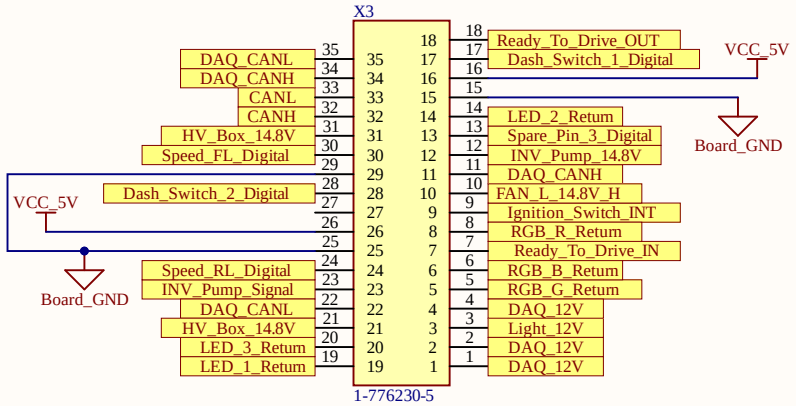
Right Body Connector



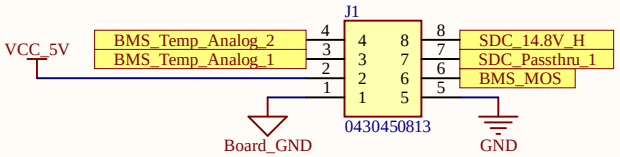
Powertrain Connector



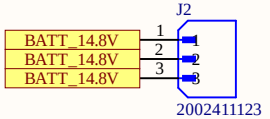
Left Body Connector



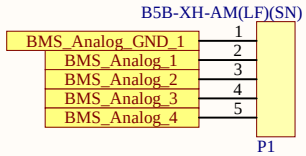
Internal Connector



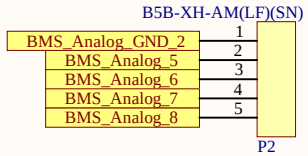
Battery Connector



BMS Connector 1



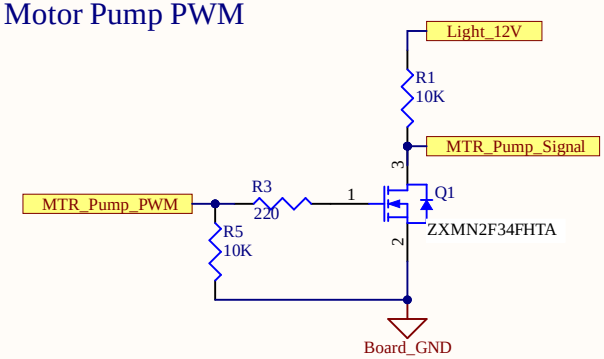
BMS Connector 2



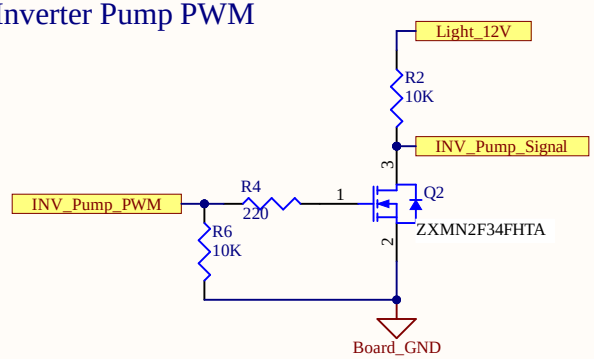
ACM_GND was on powertrain harness, can use spare ground (Board_GND) on left body connector if harness want ACM_GND with the ACM_14.8V

Title: Connectors		
Size: A4	Number: 5	Revision: v.3.0
Date: 3-26-2022		Sheet of 10
File: D:\Benjamin\..\Connector.SchDoc		Drawn By: Benjamin Liang

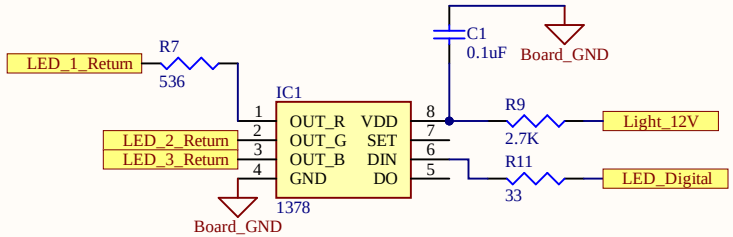
Motor Pump PWM



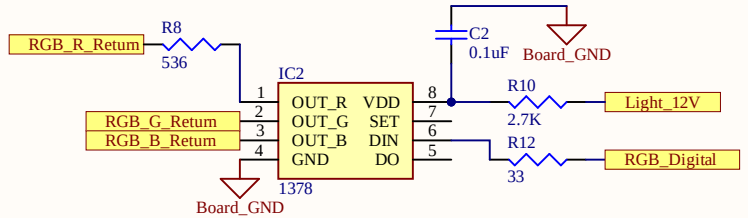
Inverter Pump PWM



LED PWM Driver

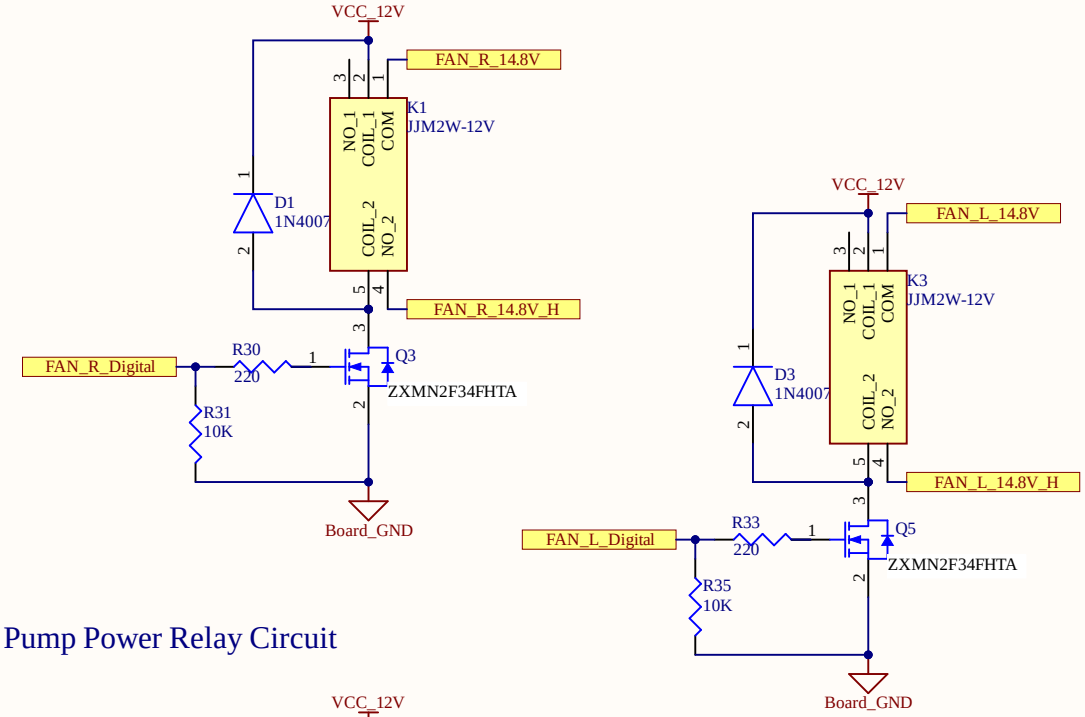


RGB PWM Driver

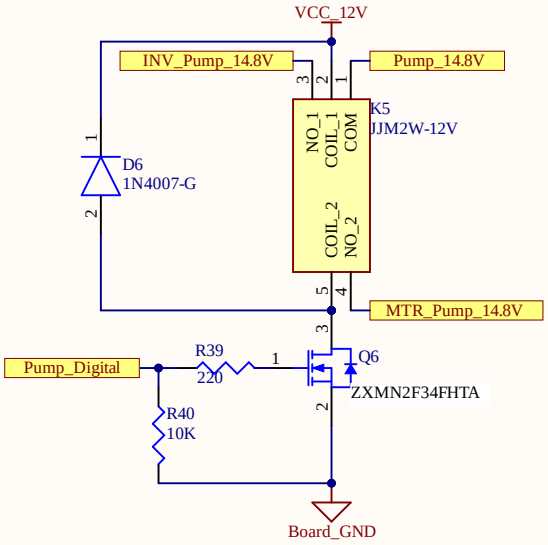


Title	Mosfet and PWM		
Size A4	Number 6		Revision v.3.0
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\PWM_Pump_Led.SchDoc		Drawn By: Benjamin Liang	

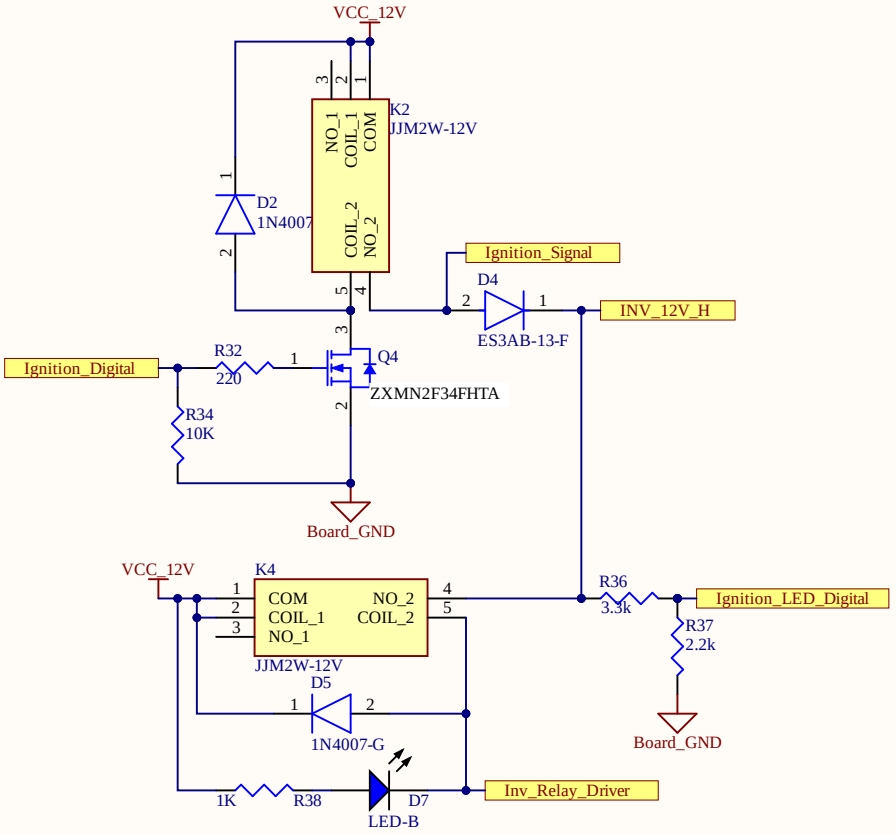
Rad Fan Power Relay Circuits



Pump Power Relay Circuit



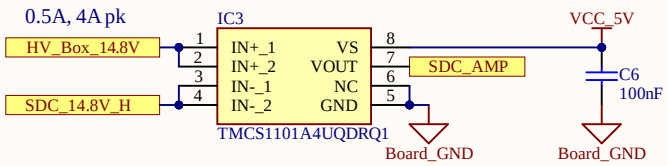
Inverter Ignition Circuit



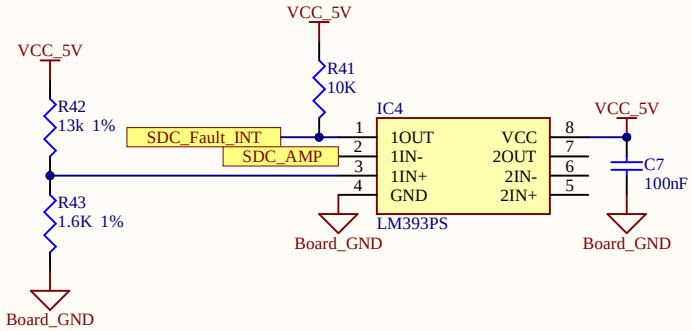
Place Flyback Diodes near coil

Title: Ignition and Multiplexer		
Size: A4	Number: 7	Revision: v.3.0
Date: 3-26-2022		Sheet of 10
File: D:\Benjamin\..\Power_Relay.SchDoc		Drawn By: Benjamin Liang

14.8V SDC Pass-Through and Current Sensor



Shutdown Circuit Current Comparator



Current Sensor: Minimize adjacent high-current traces in close proximity to the device. The input current trace can contribute additional magnetic field to the sensor if the input current traces are routed parallel to the vertical axis of the package. Merge input traces for both IN+ and IN- inputs. make sure to consider the PCB design required creepage and clearance for system-level isolation requirements.

For better sensor thermal performance: Use large copper planes for both input current path and isolated power planes and signals. Use heavier copper PCB construction. Place thermal via farms around the isolated current input.

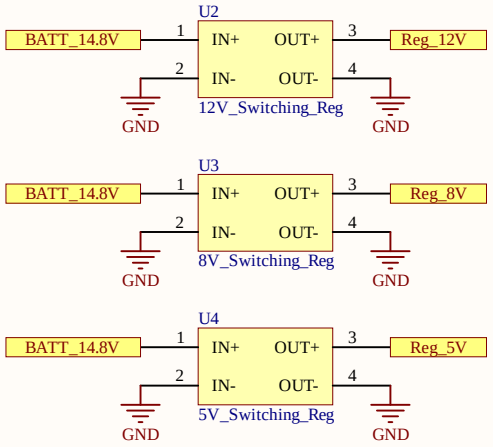
Comparator: Zero current is 0.5V, with 400mV/A sensitivity. Typical current of SDC is approx. 200mA so short circuit cut off is set at 43.1mA.

Comparator: Minimize coupling between outputs and inverting inputs to prevent output oscillations. Do not run output and inverting input traces in parallel unless there is a VCC or GND trace between output and inverting input traces to reduce coupling. Why series resistors?

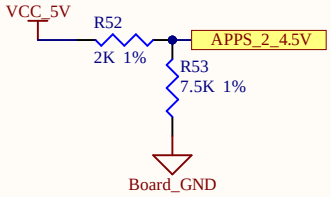
Location of current sensor IC3 can be adjusted to accomodate layout. Other possible locations include SDC pass-throughs 1 and 2.

Title	Shutdown Circuit Trip		
Size A4	Number 8		Revision v.3.0
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\Shutdown_Circuit.SchDoc		Drawn By: Benjamin Liang	

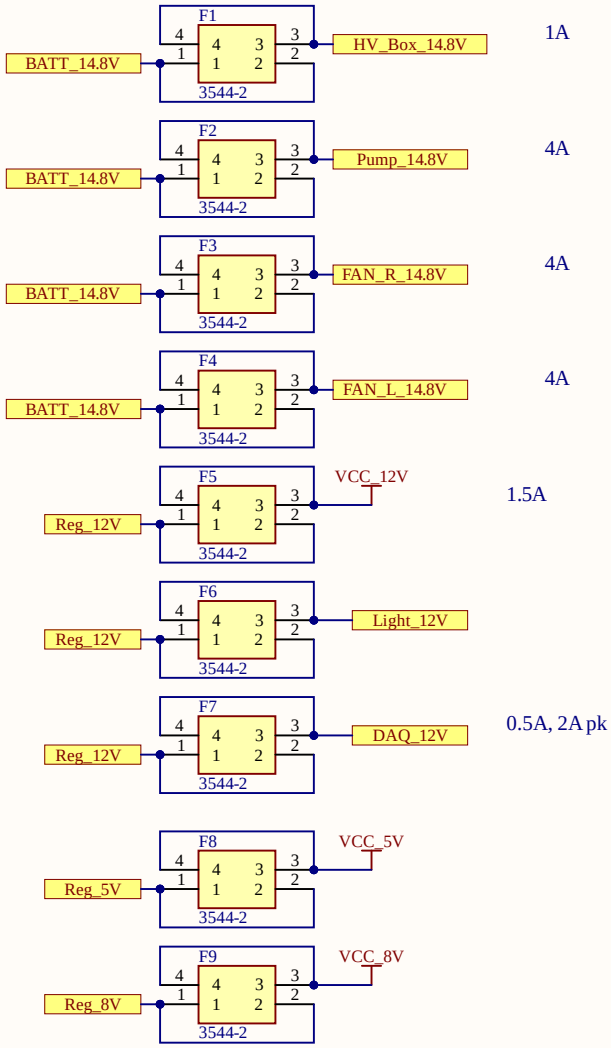
Regulators



APPS Voltage Divider

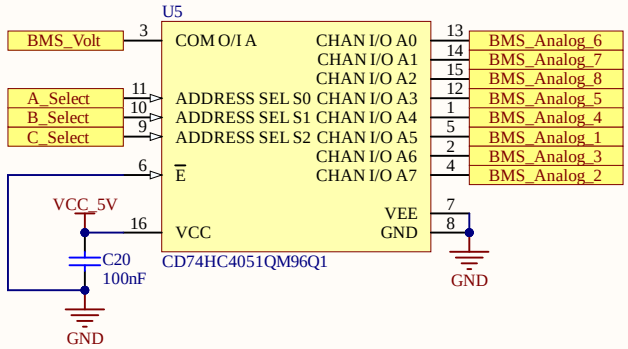


Thermal Fuses

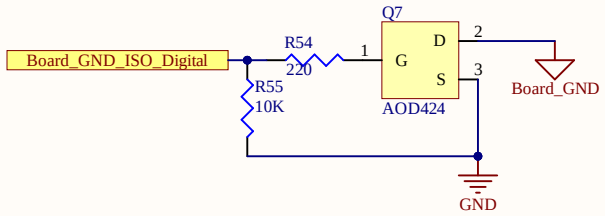


Title	Power Distribution		
Size A4	Number 9		Revision V.3.0
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\Power_Distribution.SchDoc		Drawn By: Benjamin Liang	

BMS Voltage



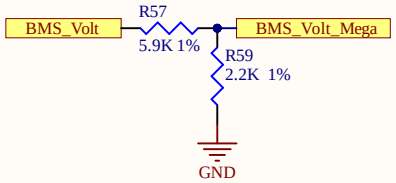
Board Ground Isolation Mosfet



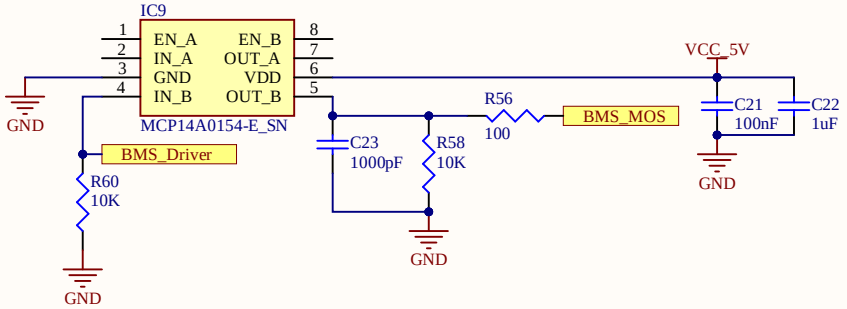
The trace loop length and inductance should be minimized by the use of ground planes or traces under the MOSFET gate drive signal. Separate analog and power grounds, and local driver decoupling should also be used. Ground place under device is recommended.

BMS voltage gets divided to a maximum of 4.563V when the battery voltage is 16.8V

BMS Voltage Divider



BMS Signal Gate Driver



Title	Power Distribution		
Size: A4	Number: 10		Revision: V.3.0
Date: 3-26-2022		Sheet of 10	
File: D:\Benjamin\..\BMS.SchDoc		Drawn By: Benjamin Liang	