

1 2 3 4

A


BRAKING IO

B

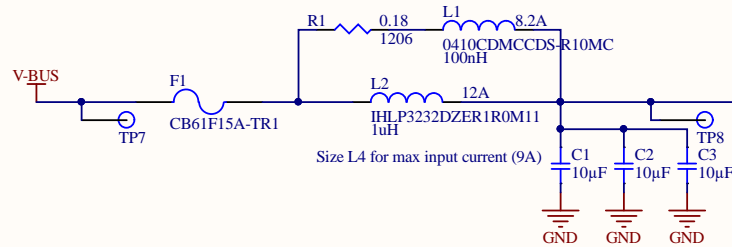
POD 5

C

REV 1

Title <i>Braking IO PCB</i>		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706		
Engineer:		Revision:		
Date: 9/8/2019	Time: 8:50:49 PM	Sheet	of	
File: braking_io.SchDoc				

should change upstream fuse to be higher current rating than downstream.

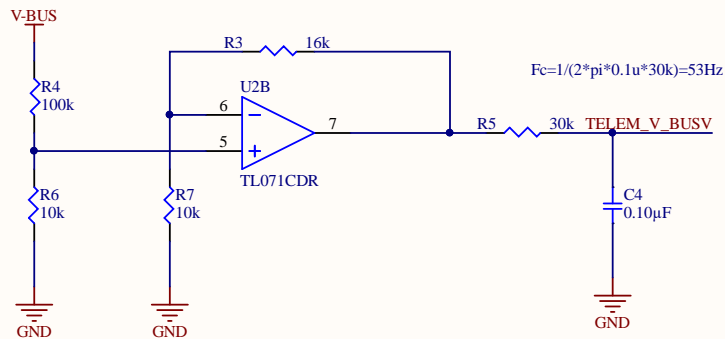


BUS_FILTER

Filter design reference: <http://www.ti.com/lit/an/snva538/snva538.pdf>
<http://ecee.colorado.edu/~rwe/papers/APEC99.pdf>

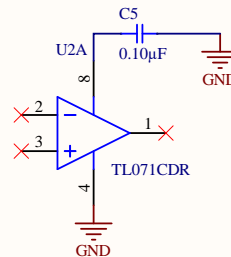
Size L4 for max input current (9A)

Max current draw: 9A -> $9A \cdot 0.01\Omega = 0.09V$
 INA Gain: 200V/V -> 4.0V at Max current
 Power: $I^2 \cdot R = 4A \cdot 0.01 = 0.04W$



GAIN: 1.6V/V
 MIN BUS VOLTAGE: 20V -> 1.82V
 MIN BUS VOLTAGE: 28V -> 2.54V

VOLTAGE TELEMETRY

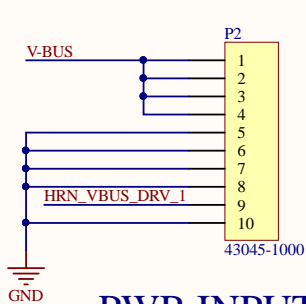


CURRENT TELEMETRY

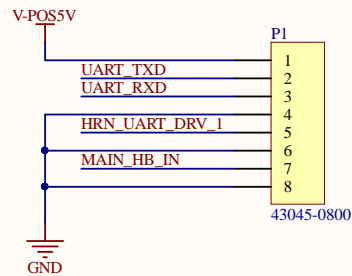
Max current draw: 9A -> $9A \cdot 0.002\Omega = 0.018V$
 INA Gain: 200V/V -> 3.6V at Max current
 Power: $I^2 \cdot R = 4A \cdot 0.01 = 0.04W$

Title		Badgerloop Electrical	
Engineer:		133 Engineering Research Building	
Date: 9/8/2019		1500 Engineering Drive	
Time: 8:50:49 PM		Madison, WI 53706	
File: bus_filter.SchDoc		Revision:	
		Sheet	of

**BADGER
LOOP**

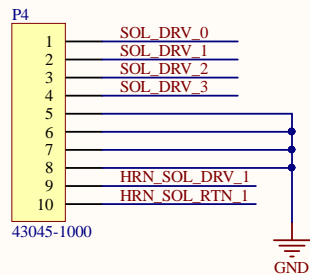


PWR INPUT



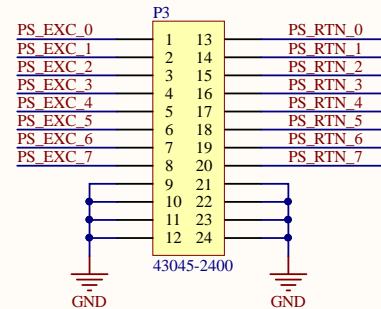
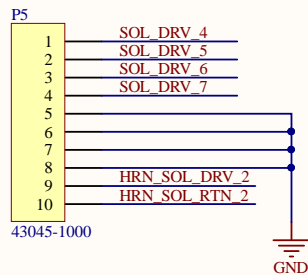
UART

DEBUG



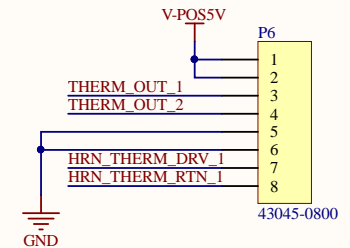
SOLENOIDS

Split into 2 connectors as only 4 solenoids are likely to be used

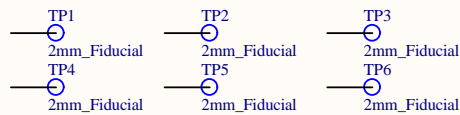


PRESSURE SENSORS

TODO UPDATE TO 24 PIN

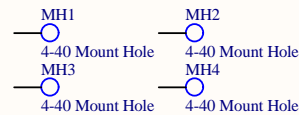


THERMISTORS



Fiducials

Place on four corners of board

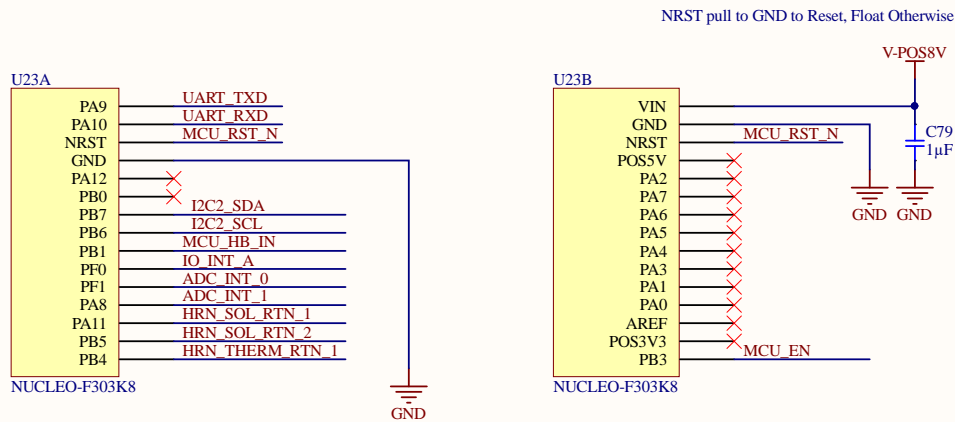


Mount Holes

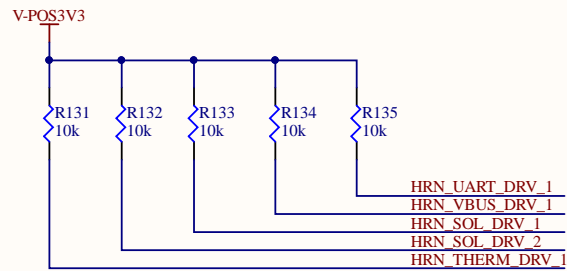
Avoid routing under screw head

Title Connectors		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:	Sheet of	
Date: 9/8/2019	Time: 8:50:49 PM		
File: connectors.SchDoc			

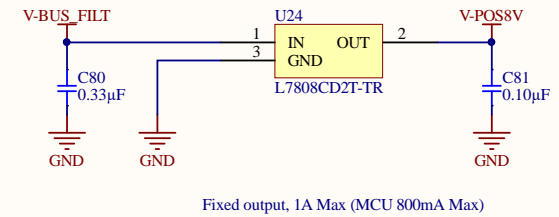




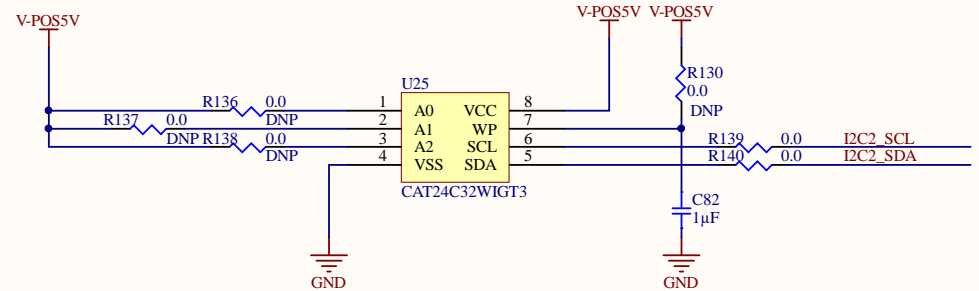
MCU BREAKOUT



HARNESS ID



8V LDO



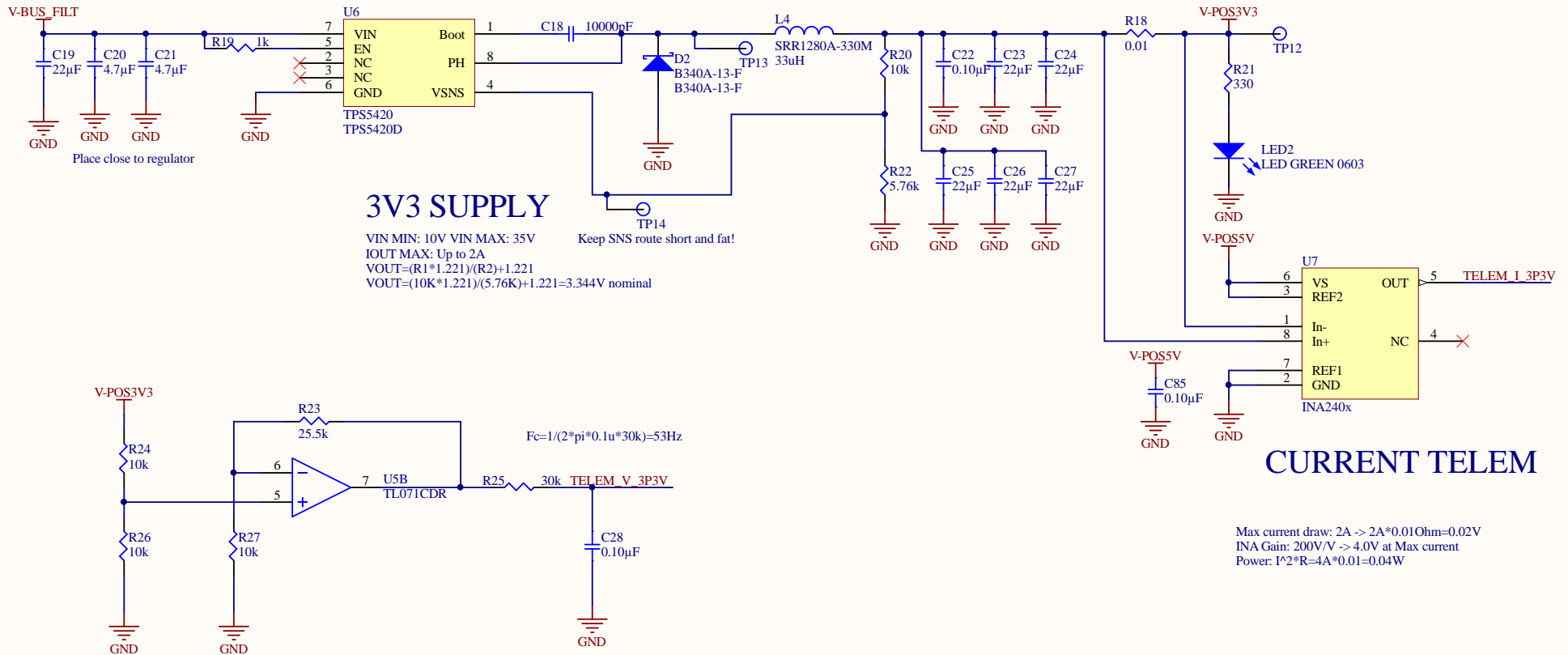
I2C EEPROM

Title Microcontroller		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:		
Date: 9/8/2019	Time: 8:50:50 PM		
File: mcu.SchDoc	Sheet of		

Notes:
Follow layout reference design
Place bypass caps close to regulator
Keep hot loops as short as possible
Possible to replace ceramic bulk cap with a tantalum.

Replace with Tantalum?
Place close to regulator
See https://github.com/badgerloop-software/hardware/tree/master/braking_io/design

TODO: Spec new inductor



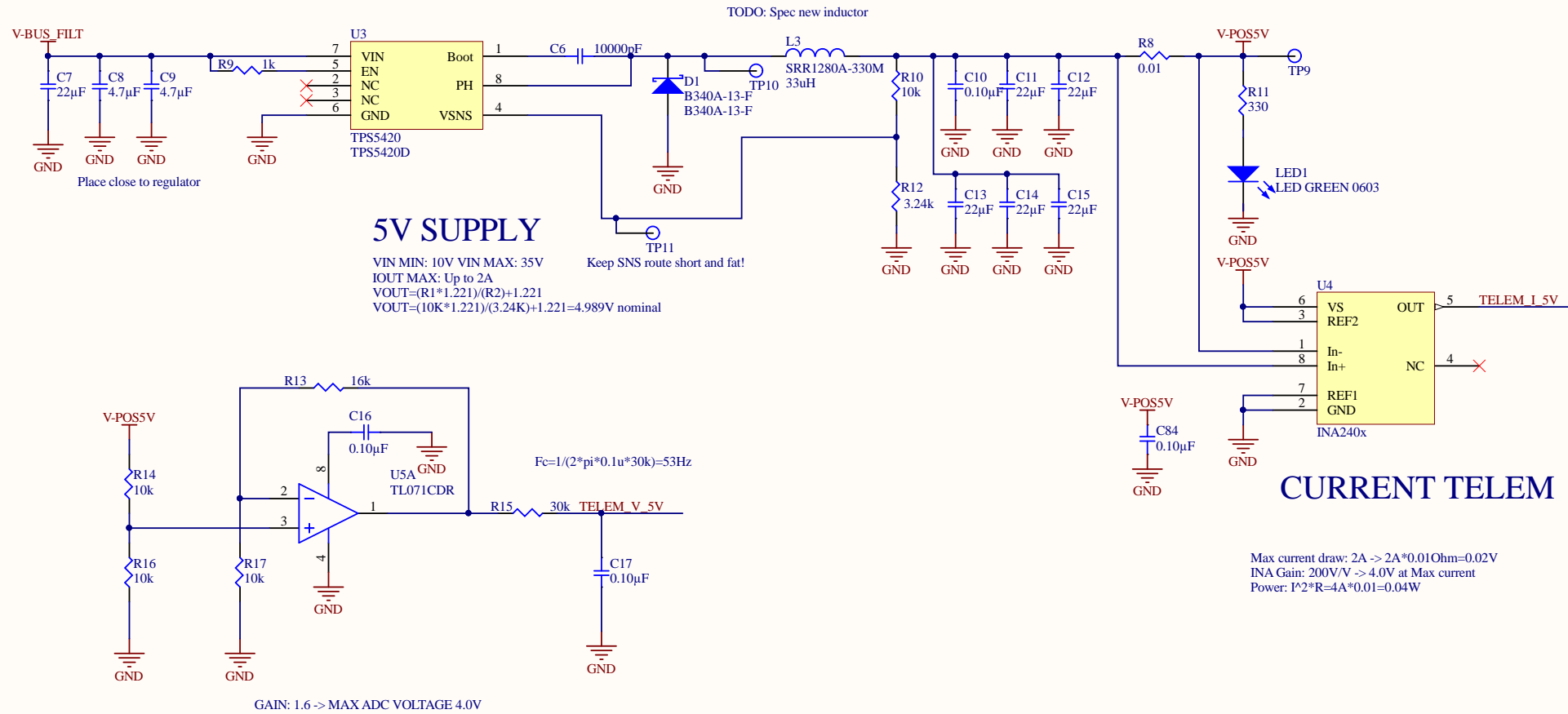
GAIN: 2.55 -> MAX ADC VOLTAGE 4.21V


VOLTAGE TELEMETRY

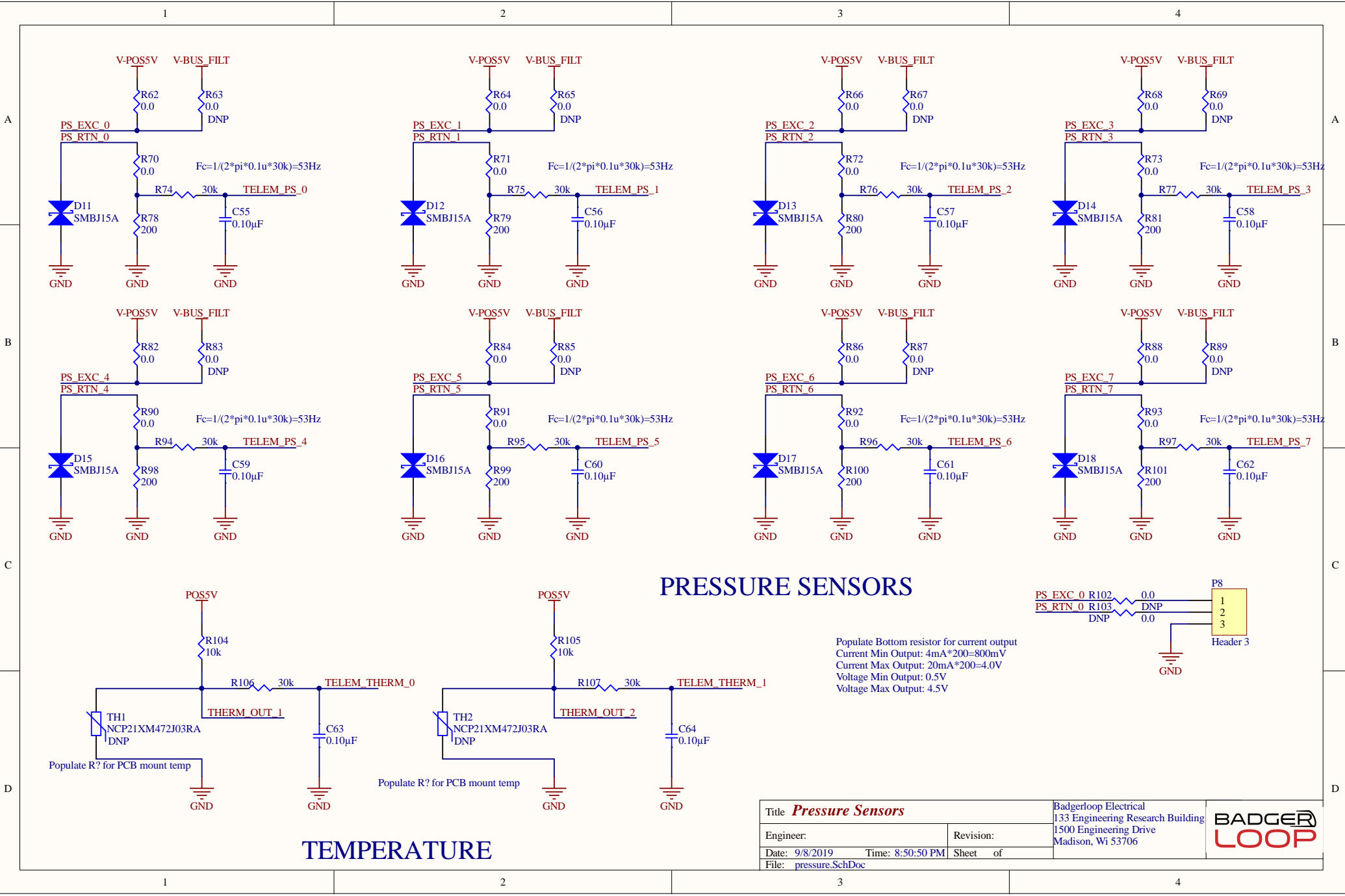
Title 3V3 SUPPLY		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:	Sheet of	
Date: 9/8/2019	Time: 8:50:50 PM		
File: power_3V3.SchDoc		BADGER LOOP	

Notes:
 Follow layout reference design
 Place bypass caps close to regulator
 Keep hot loops as short as possible
 Possible to replace ceramic bulk cap with a tantalum.

Replace with Tantalum?
 Place close to regulator
[See https://github.com/badgerloop-software/hardware/tree/master/braking_io/design](https://github.com/badgerloop-software/hardware/tree/master/braking_io/design)

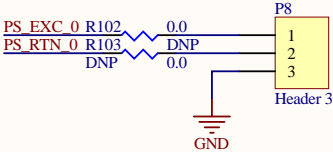


Title		Badgerloop Electrical		
Engineer:		133 Engineering Research Building		
Date: 9/8/2019	Time: 8:50:50 PM	1500 Engineering Drive		
File: power_5V.SchDoc		Madison, WI 53706		
Revision:		Sheet of		



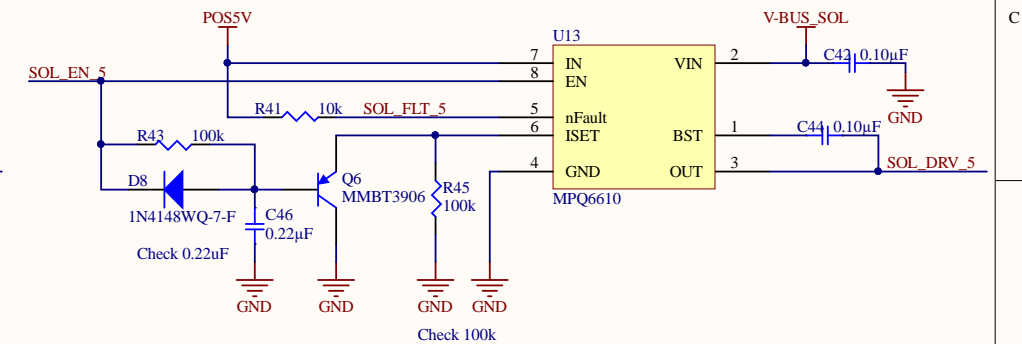
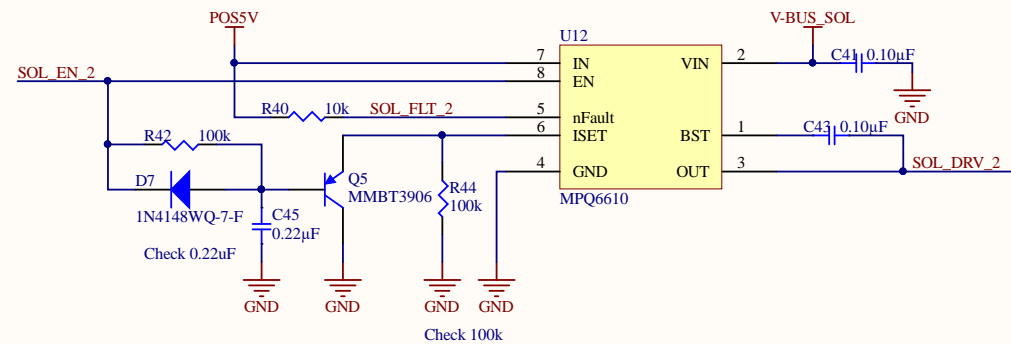
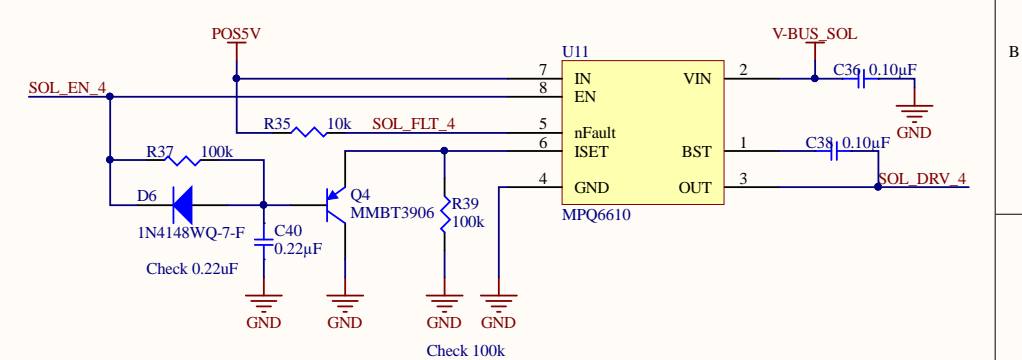
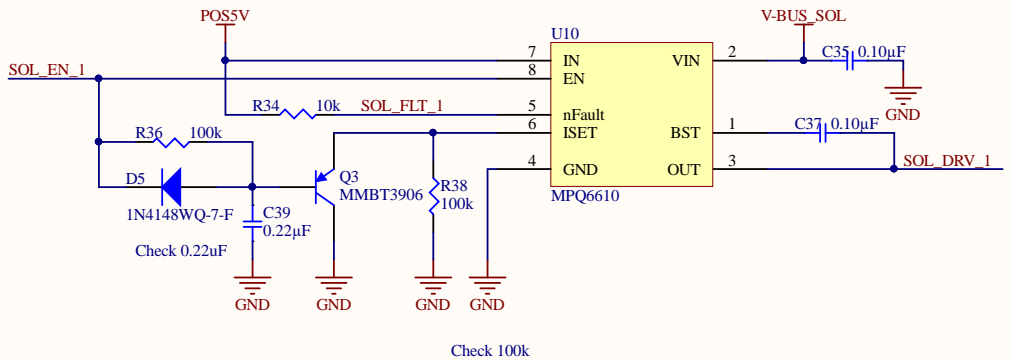
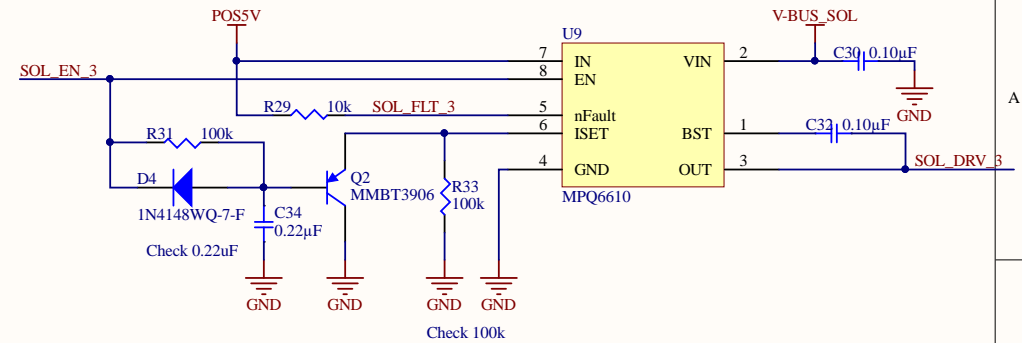
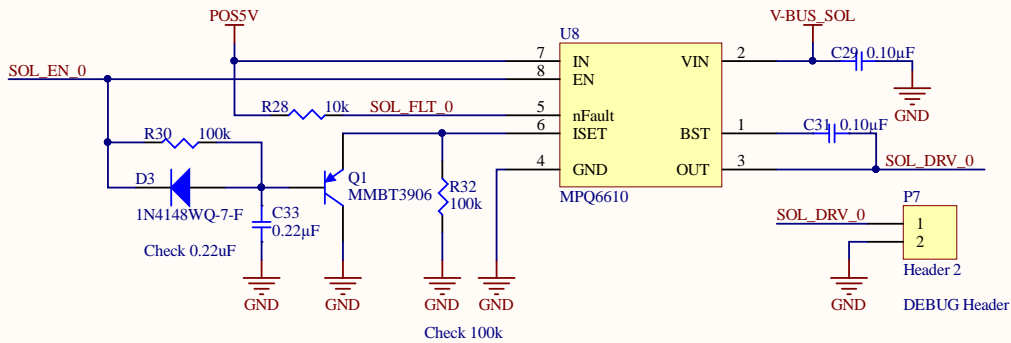
PRESSURE SENSORS

Populate Bottom resistor for current output
Current Min Output: 4mA*200=800mV
Current Max Output: 20mA*200=4.0V
Voltage Min Output: 0.5V
Voltage Max Output: 4.5V



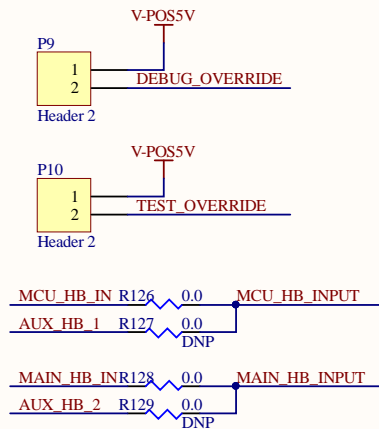
TEMPERATURE

Title Pressure Sensors		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:	BADGER LOOP	
Date: 9/8/2019	Time: 8:50:50 PM		
File: pressure.SchDoc	Sheet of		

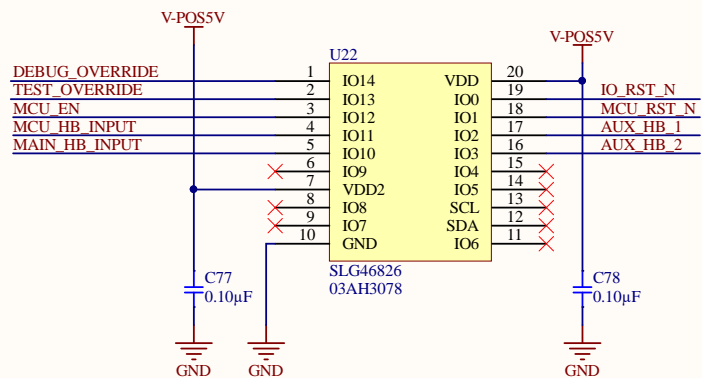


SOLENOID DRIVE

Title Solenoids		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:	BADGER LOOP	
Date: 9/8/2019	Time: 8:50:50 PM		
File: solenoid.SchDoc		Sheet	of



DEBUG



WATCHDOG AND RESET CONTROLLER

IO pin selection is arbitrary. Can be adjusted internally for better layout
Currently- Inputs on Left, outputs on right

Modes of operation:

Debug: EN signal is always on when SLG has power

Populate Jumper 1

Test: 10Hz signal internal signal is recirculated to mimic heartbeat

Populate Jumper 2


Operation: U? expects 10Hz heartbeat. If no heartbeat for 1s after 20s Power on reset

MCP RST_N will fall and MCU RST_N will pulse for 200ms

Silego Image here:

<https://github.com/badgerloop-software/hardware/blob/master/silego/watchdog.gp6>

Silego Image PDF Outputs:

Title <i>Watchdog</i>			Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706		
Engineer:		Revision:			
Date: 9/8/2019	Time: 8:50:51 PM	Sheet of			
File: watchdog.SchDoc					