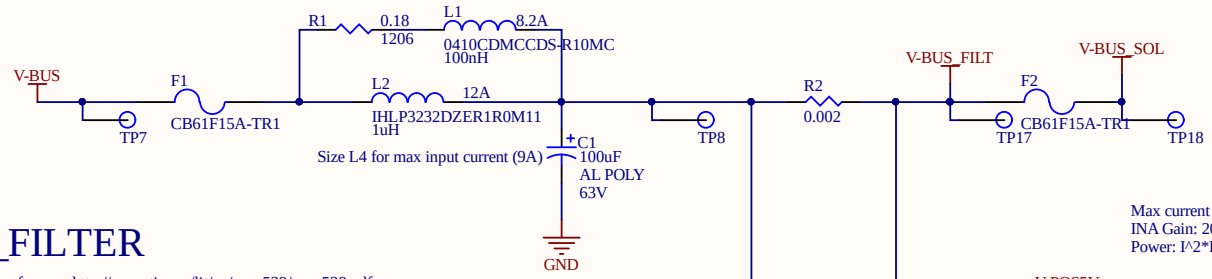
BRAKING IO

POD 5

REV 1

Title	***Braking IO PCB***	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:18 PM	Sheet of	
File: braking_io.SchDoc		

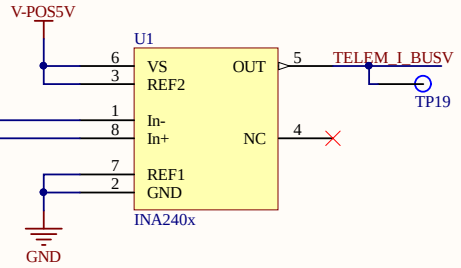
should change upstream fuse to be higher current rating than downstream.



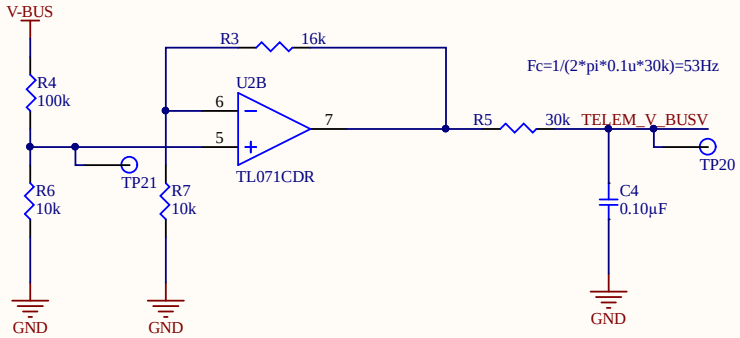
BUS_FILTER

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

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

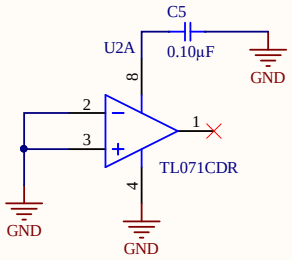


CURRENT TELEM



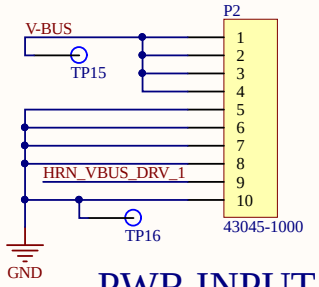
GAIN: 1.6V/V
MIN BUS VOLTAGE: 20V -> 1.82V
MIN BUS VOLTAGE: 28V -> 2.54V

VOLTAGE TELEMETRY

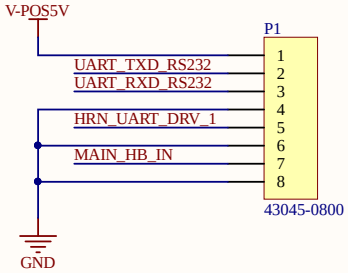


Max current draw: 9A -> 9A*0.002Ohm=0.018V
INA Gain: 200V/V -> 3.6V at Max current
Power: I^2*R=4A*0.01=0.04W

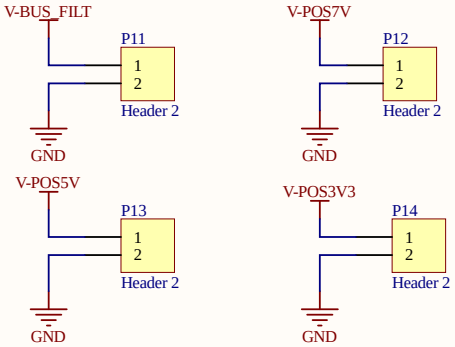
Title **Bus Filter**		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:19 PM	Sheet of	
File: bus_filter.SchDoc		



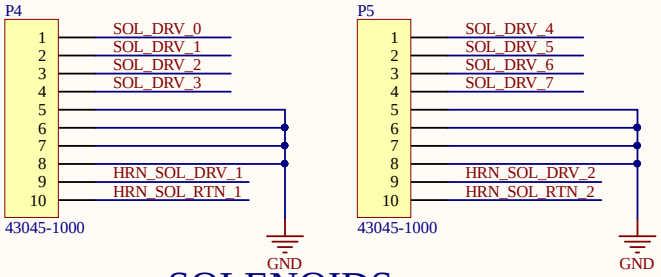
PWR INPUT



UART

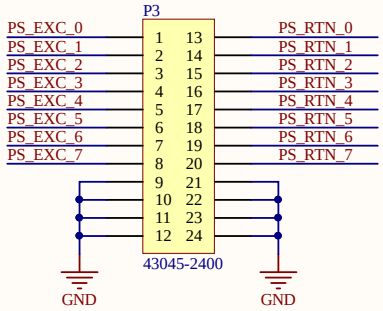


DEBUG

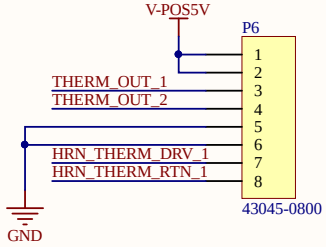


SOLENOIDS

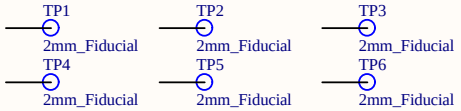
Split into 2 connectors as only 4 solenoids are likely to be used



PRESSURE SENSORS

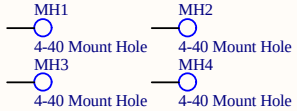


THERMISTORS



Fiducals

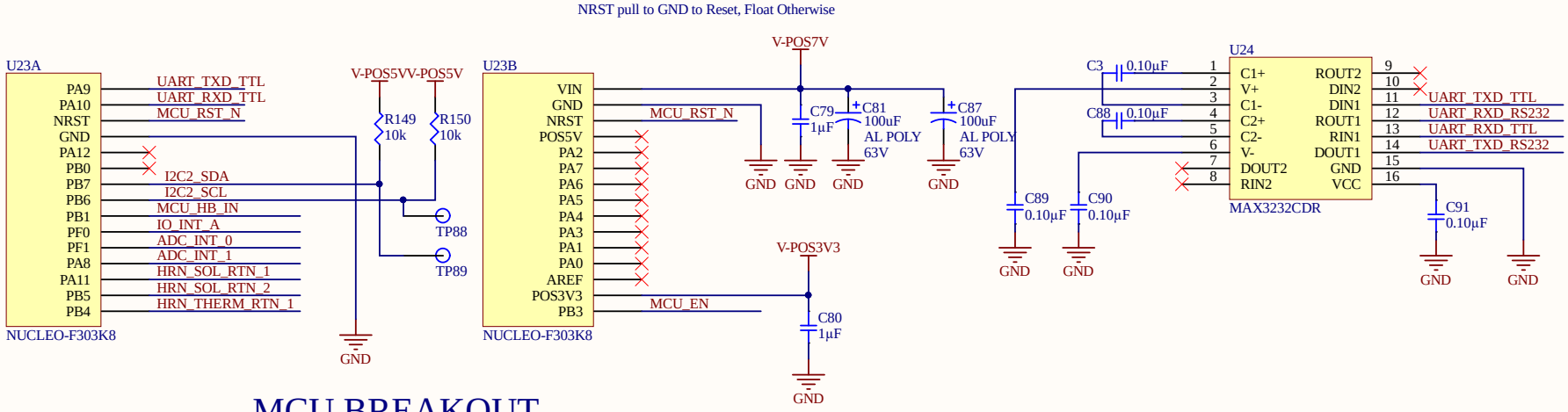
Place on four corners of board



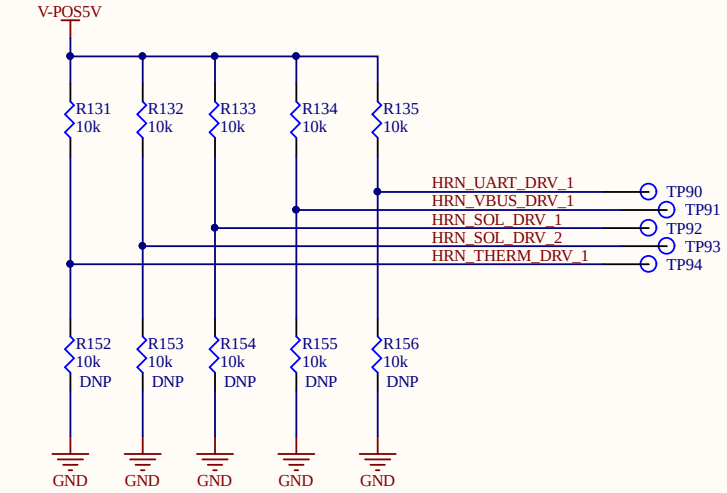
Mount Holes

Avoid routing under screw head

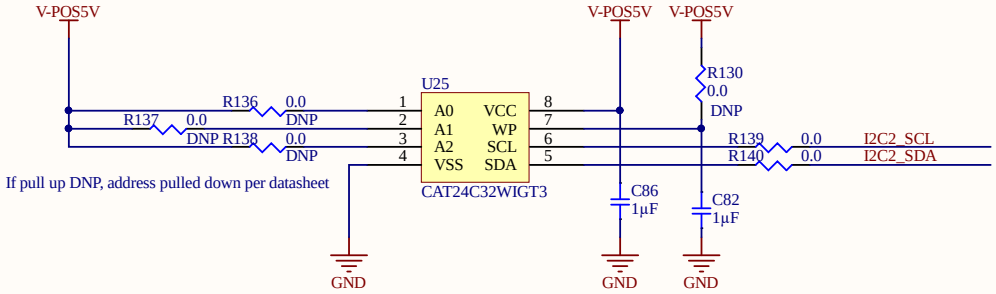
Title	***Connectors***	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:19 PM	Sheet of	
File: connectors.SchDoc		



MCU BREAKOUT



HARNESS ID



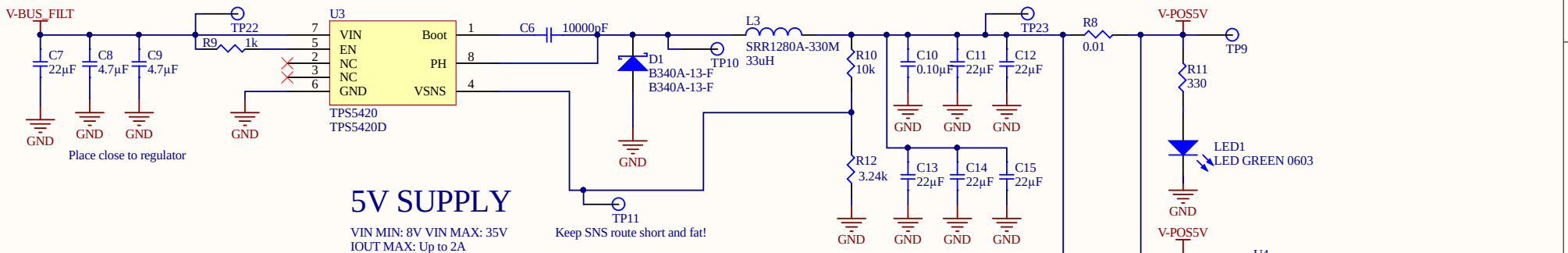
Default I2C Address: 0x50h

I2C EEPROM

Title	***Microcontroller***	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:20 PM	Sheet of	
File: mcu.SchDoc		

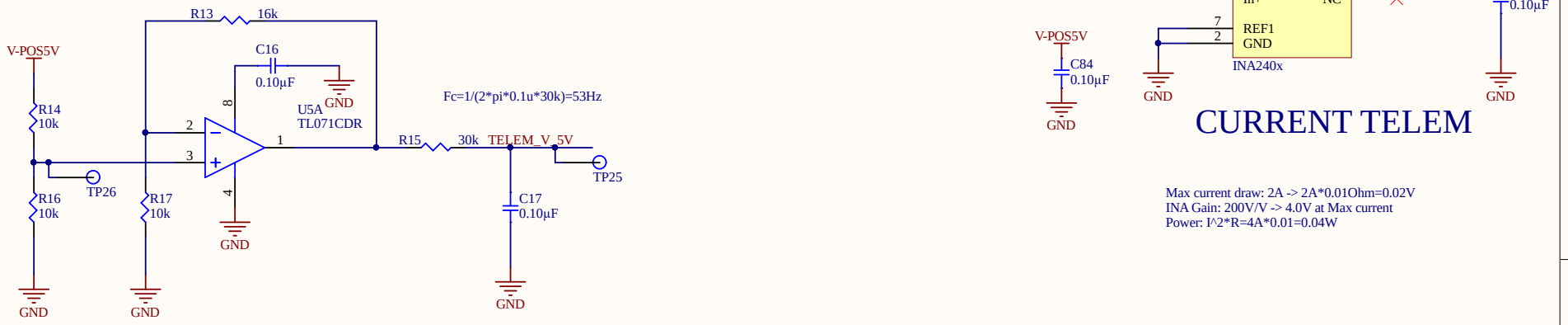
Notes:
Follow layout reference design
Place bypass caps close to regulator
Keep hot loops as short as possible
Possible to replace ceramic bulk cap with a tantalum.

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



5V SUPPLY

VIN MIN: 8V VIN MAX: 35V
IOUT MAX: Up to 2A
VOUT=(R1*1.221)/(R2)+1.221
VOUT=(10K*1.221)/(3.24K)+1.221=4.989V nominal



CURRENT TELEM

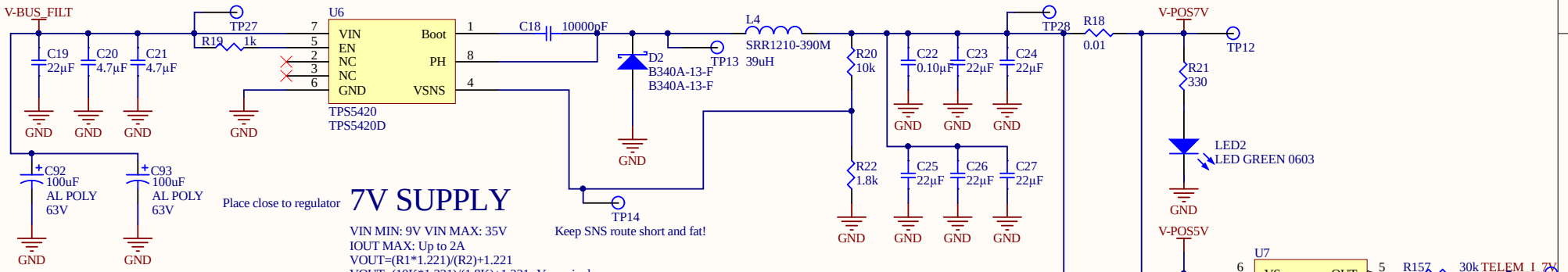
Max current draw: 2A -> 2A*0.01Ohm=0.02V
INA Gain: 200V/V -> 4.0V at Max current
Power: I^2*R=4A*0.01=0.04W

VOLTAGE TELEMETRY

Title		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:20 PM	Sheet of	
File: power_5V.SchDoc		

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



Place close to regulator

7V SUPPLY

VIN MIN: 9V VIN MAX: 35V
IOUT MAX: Up to 2A
VOUT=(R1*1.221)/(R2)+1.221
VOUT=(10K*1.221)/(1.8K)+1.221=V nominal

Keep SNS route short and fat!

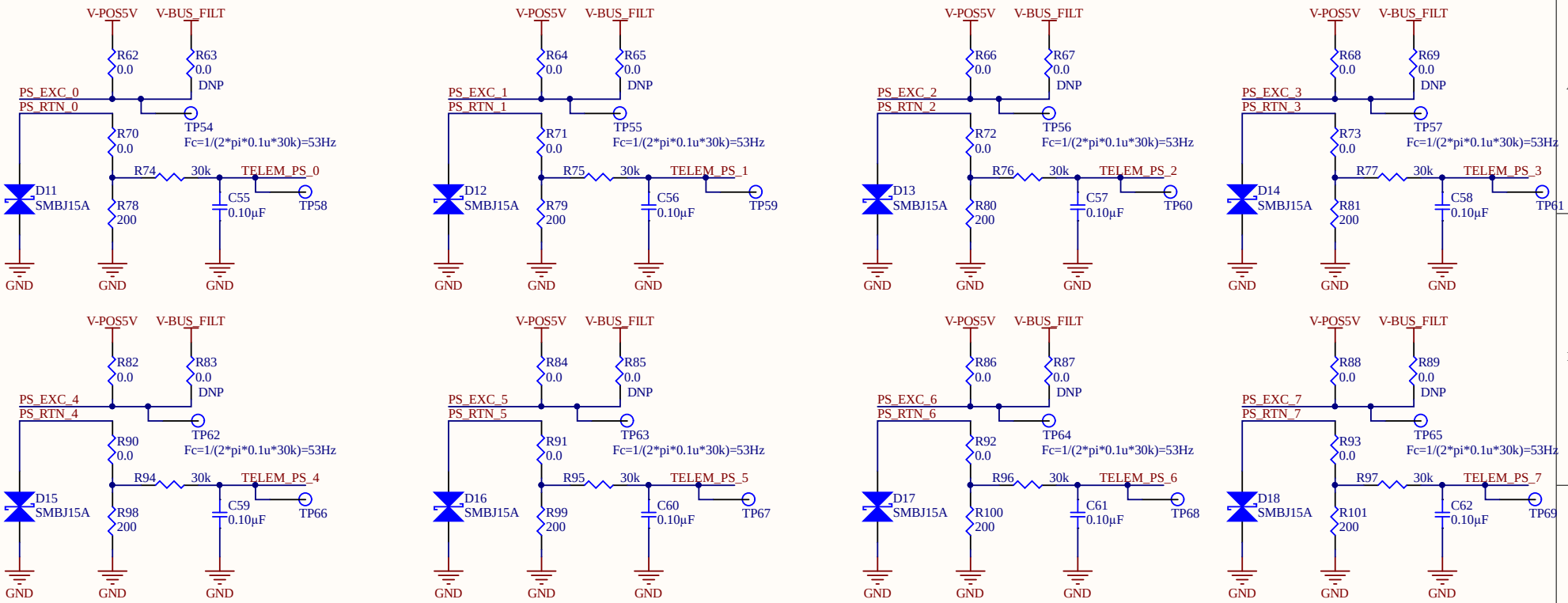
CURRENT TELEM

Max current draw: 2A -> 2A*0.01Ohm=0.02V
INA Gain: 200V/V -> 4.0V at Max current
Power: I^2*R=4A*0.01=0.04W

GAIN: 1.2 -> MAX ADC VOLTAGE 4.20V

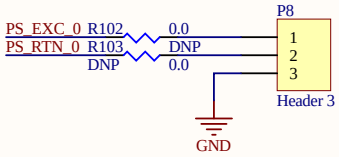
VOLTAGE TELEMETRY

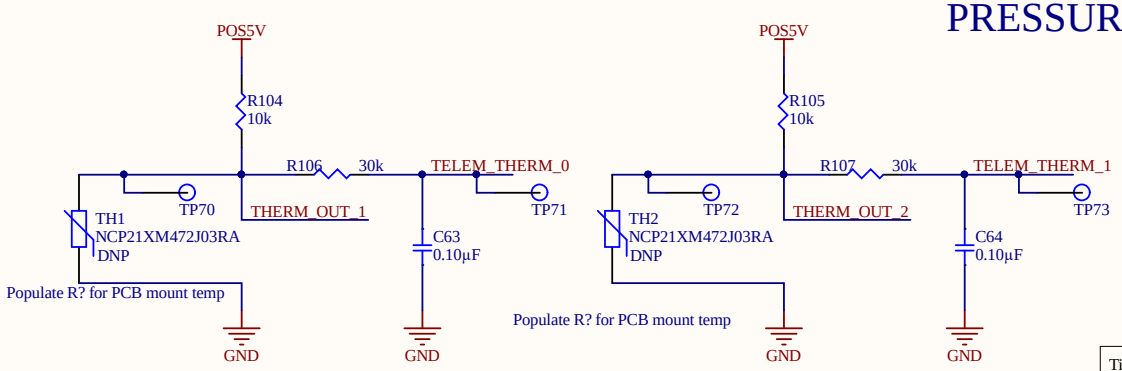
Title *7V SUPPLY*		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:21 PM	Sheet of	
File: power_7V.SchDoc		



PRESSURE SENSORS

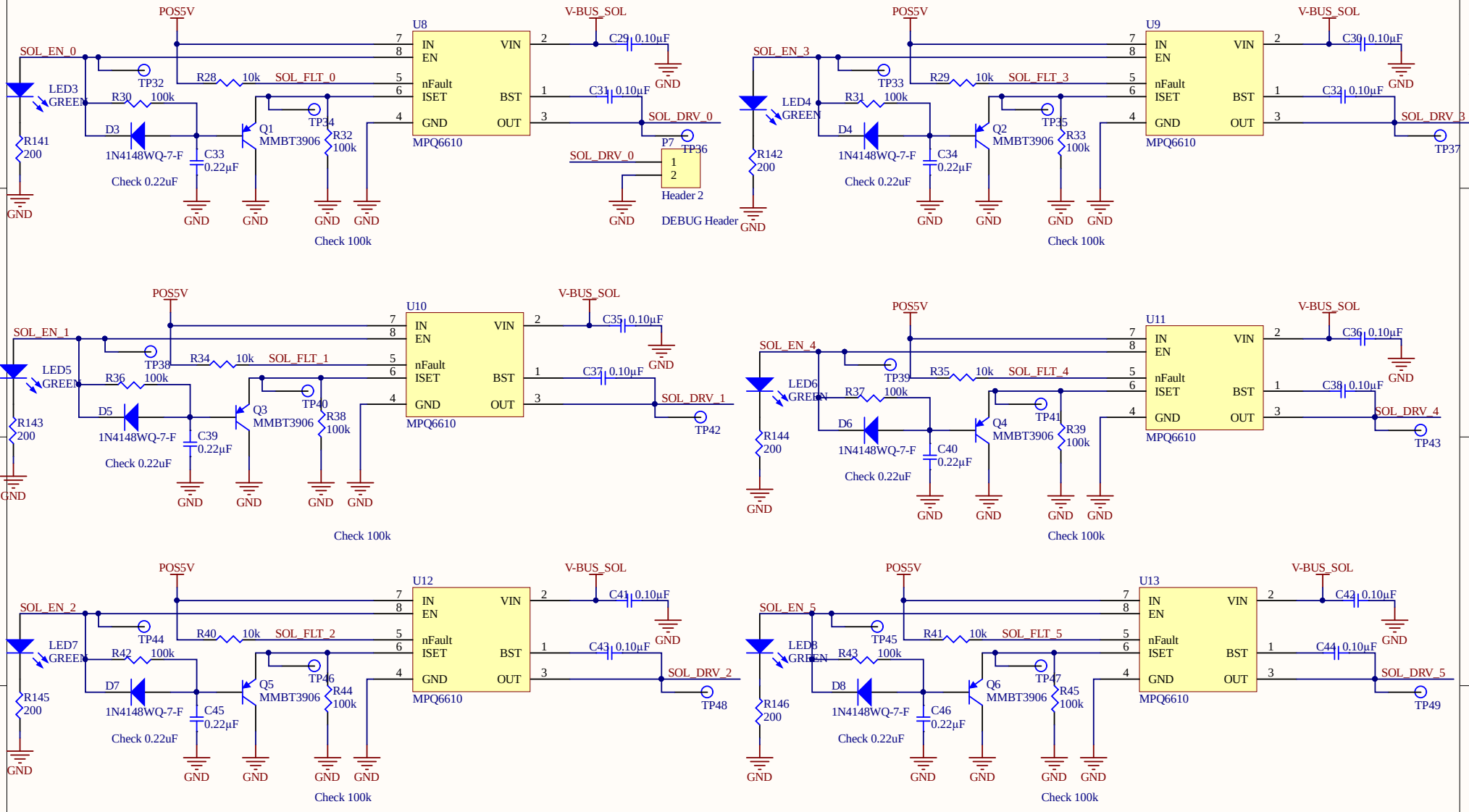
Populate Bottom resistor for current output
Current Min Output: 4mA*200=800mV
Current Max Output: 20mA*200=4.0V
Voltage Min Output: 0.5V
Voltage Max Output: 4.5V





TEMPERATURE

Title	***Pressure Sensors***	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:22 PM	Sheet of	
File: pressure.SchDoc		

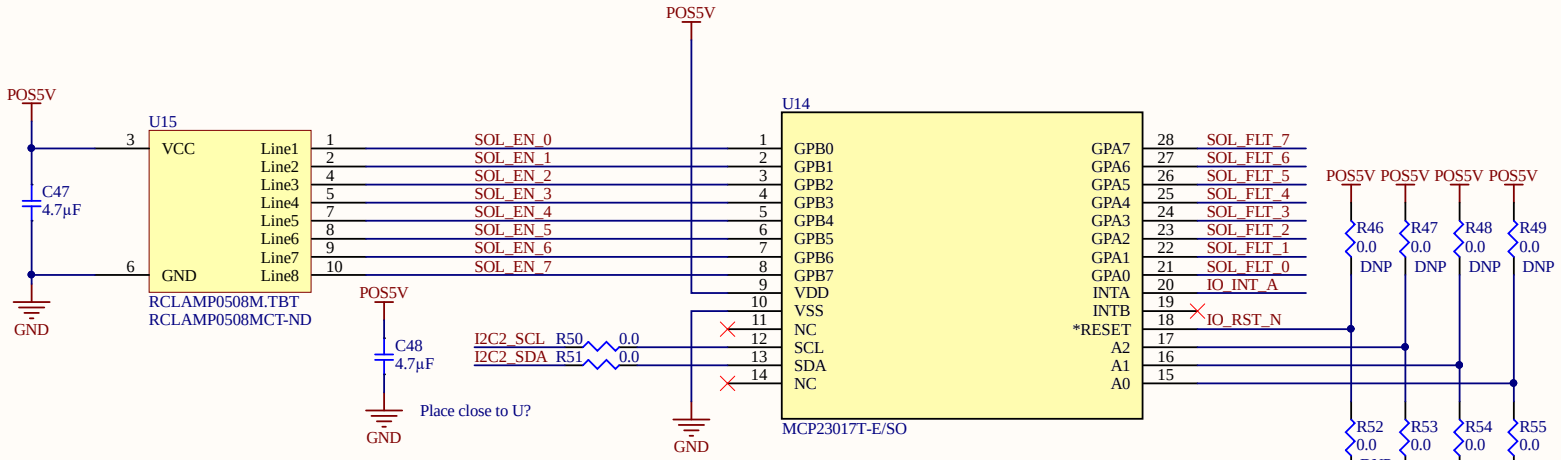


SOLENOID DRIVE

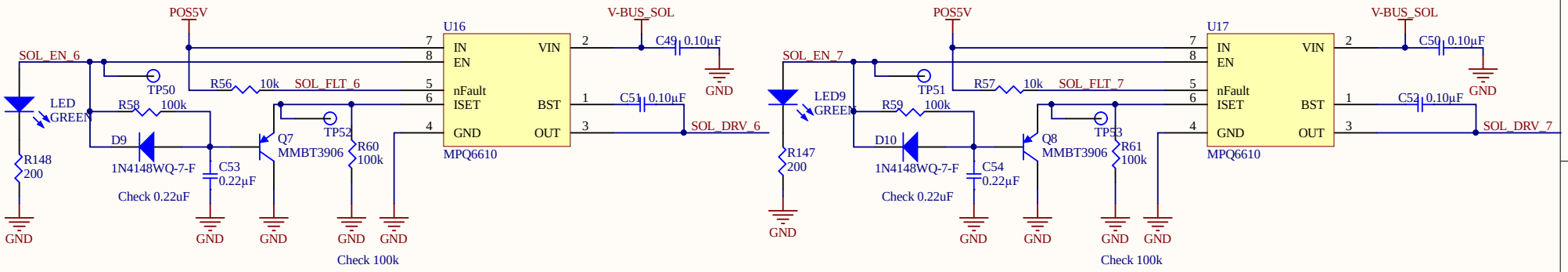
Title	***Solenoids***	
Engineer:		Revision:
Date: 9/13/2019	Time: 1:24:22 PM	Sheet of
File: solenoid.SchDoc		

Badgerloop Electrical
133 Engineering Research Building
1500 Engineering Drive
Madison, Wi 53706

BADGER LOOP

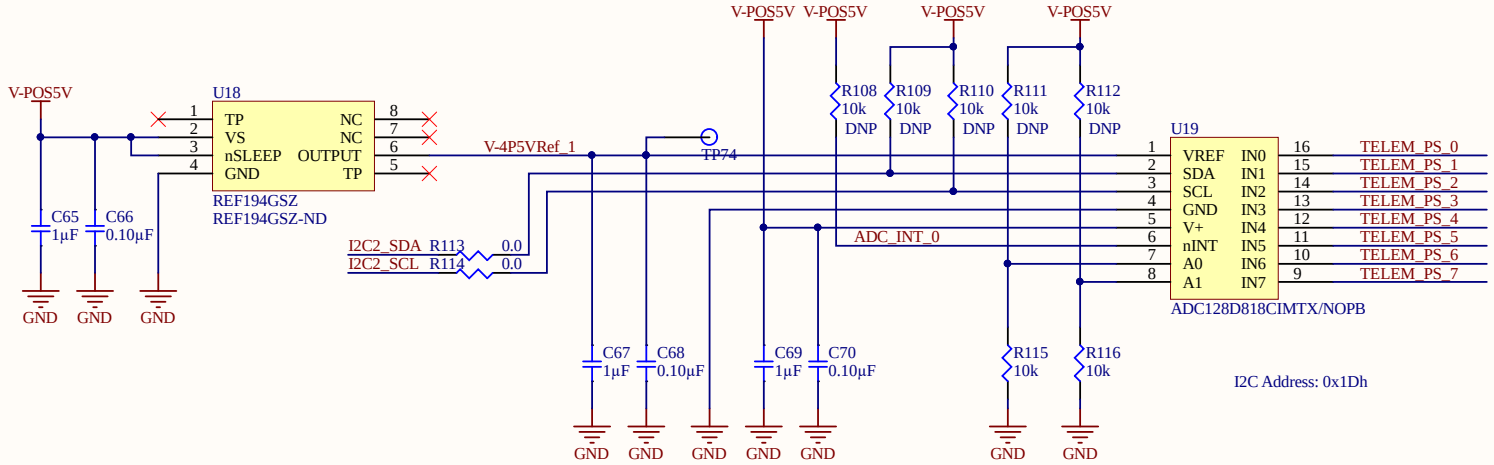


SOLENOID CONTROL

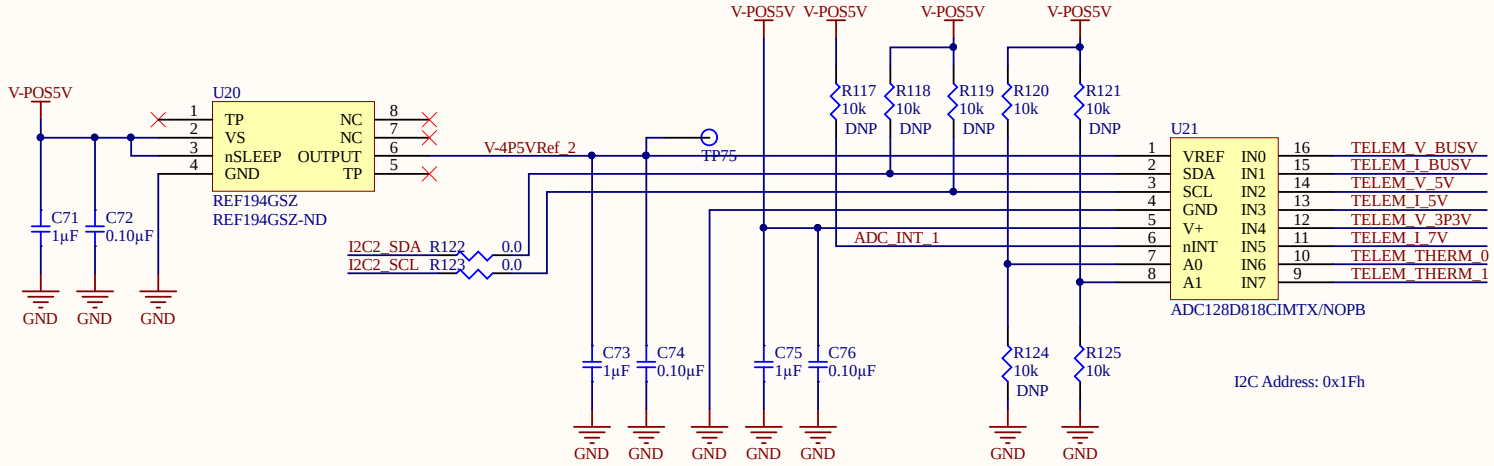


SOLENOID DRIVE

Title	***Solenoid Control***	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:23 PM	Sheet of	
File: solenoid_drv.SchDoc		

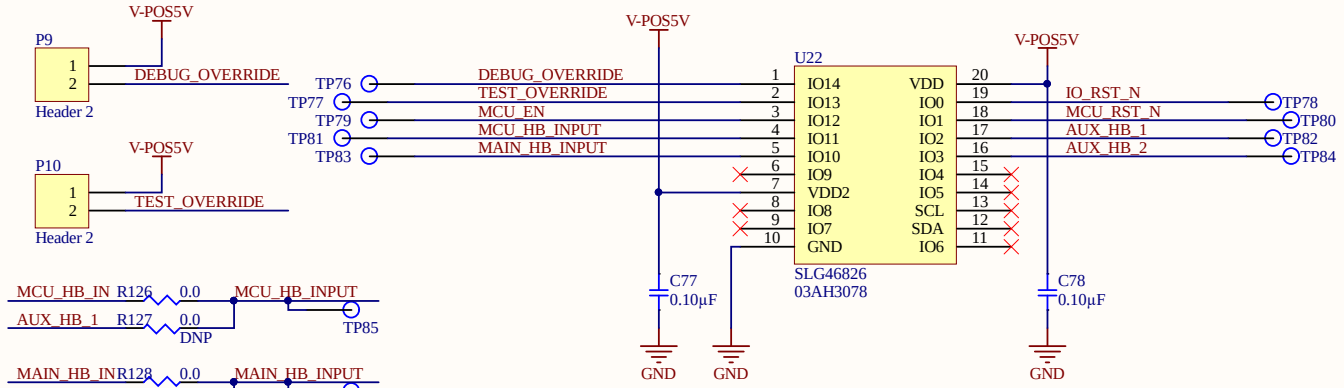


PRESSURE



RAIL AND TEMPERATURE

Title **ADC**		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:24 PM	Sheet of	
File: telemetry_adc.SchDoc		



WATCHDOG AND RESET CONTROLLER

DEBUG

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 recircuilated 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 *Watchdog*		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 9/13/2019 Time: 1:24:24 PM	Sheet of	
File: watchdog.SchDoc		