

A

A

B

B

C

C

D

D

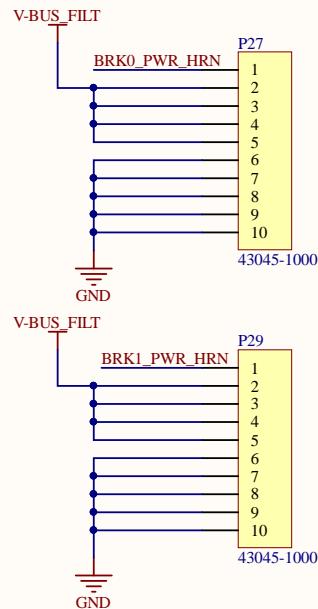
MAIN IO

POD 5

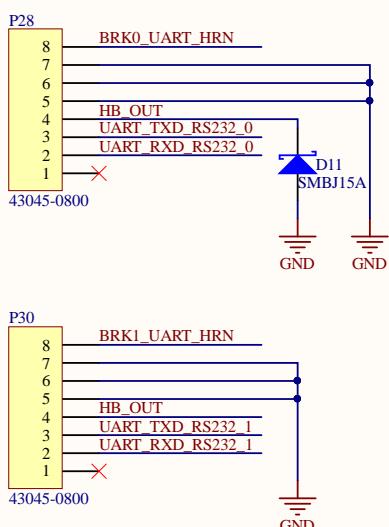
REV 1

Title Main IO		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706	BADGER LOOP
Engineer:	Revision:	Date: 3/6/2021 Time: 10:37:21 PM Sheet 1 of	

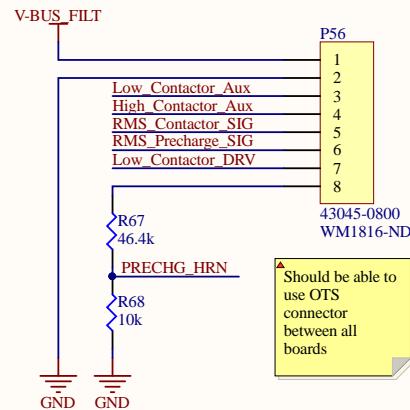
BrakingIO PWR



BrakingIO UART



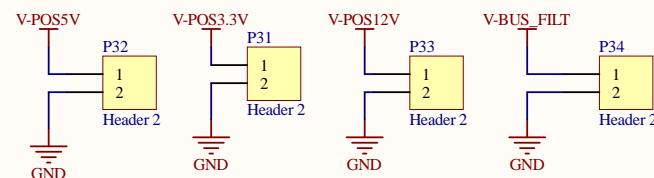
Precharge Board



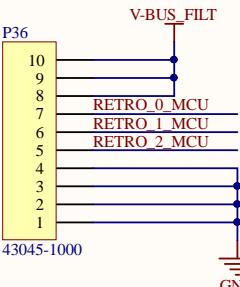
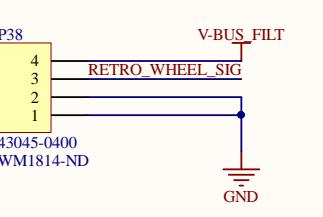
BMS & RMS

See respective schematics

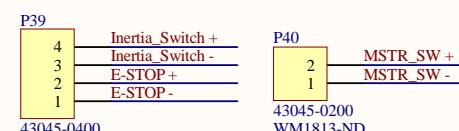
Debug



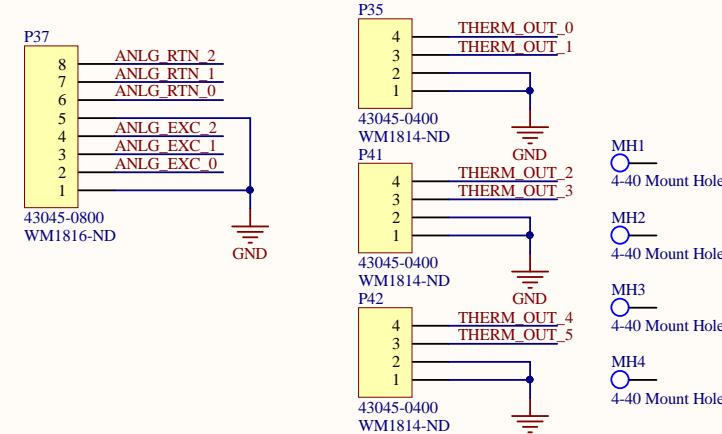
Retro Sensors



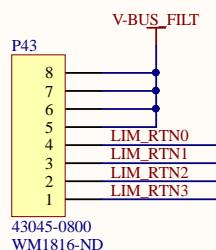
Shutdown Circuit Inputs



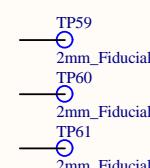
Analog Sensors



Limit Switches

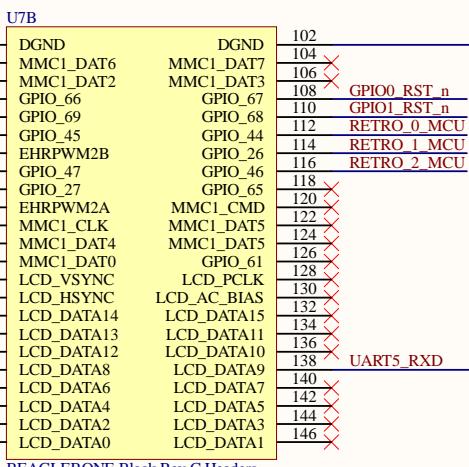
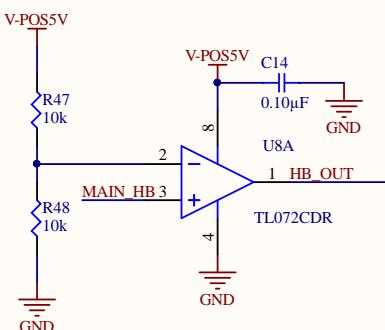
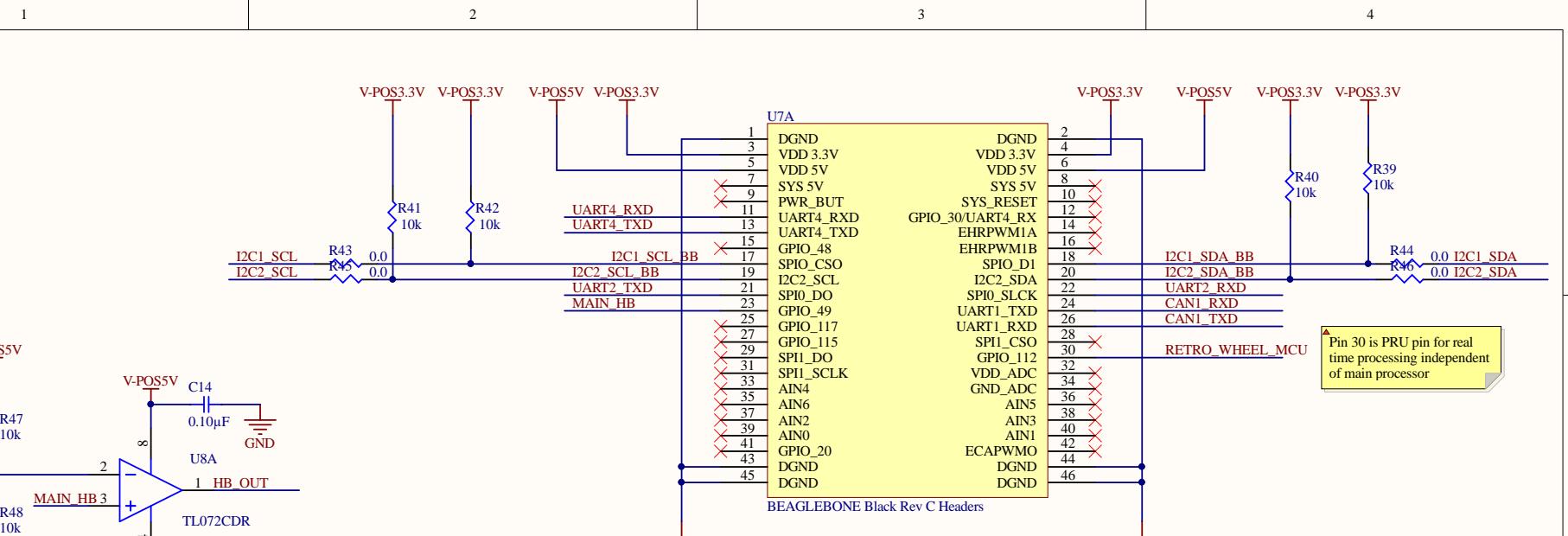


Fiducials

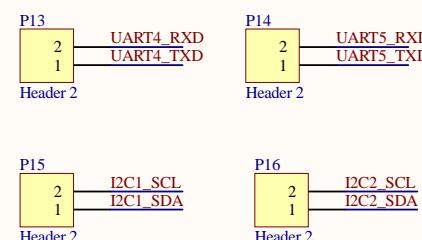


Title Connectors

Engineer:	Revision:	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Date: 3/6/2021	Time: 10:37:21 PM	Sheet 2 of
File: connectors.SchDoc		BADGER LOOP

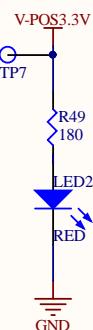


Beaglebone Headers



Debug Header

Title Beaglebone		Badgerloop Electrical
Engineer:	Revision:	133 Engineering Research Building
Date: 3/6/2021	Time: 10:37:21 PM	1500 Engineering Drive
File: beaglebone.SchDoc		Madison, Wi 53706



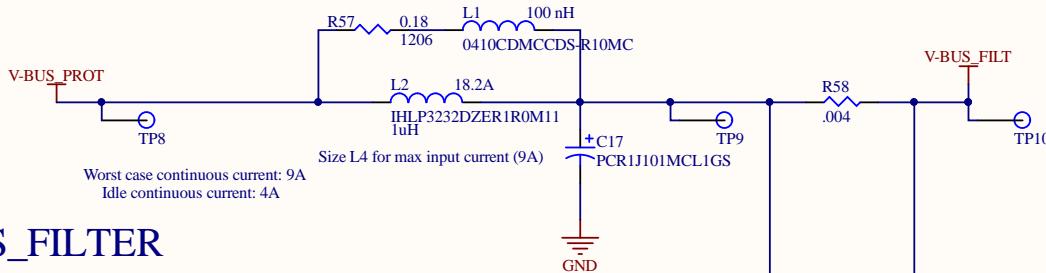
1

2

3

4

A

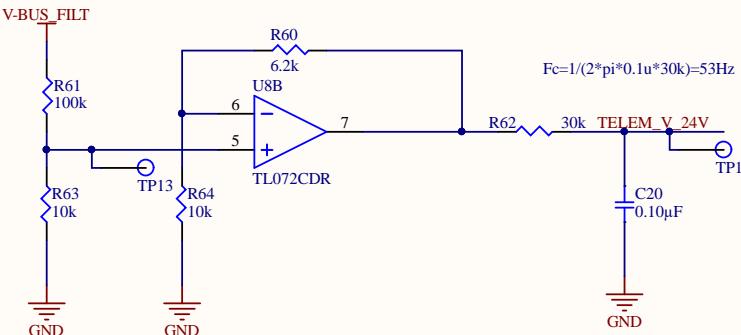


BUS_FILTER

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

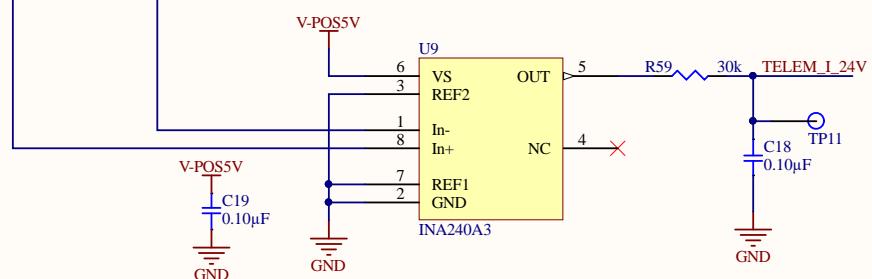
Max current draw: 9A > 9A*0.004Ω=0.036V
 INA Gain: 100V/V > 3.6V at Max current
 Power: $I^2 \cdot R = 81 \cdot 0.004 = 0.324W$

B



GAIN: 1.62V/V
 MIN BUS VOLTAGE: 20V > 2.9V
 MAX BUS VOLTAGE: 28V > 4.12

VOLTAGE TELEMETRY



CURRENT TELEM

BUS FILTER

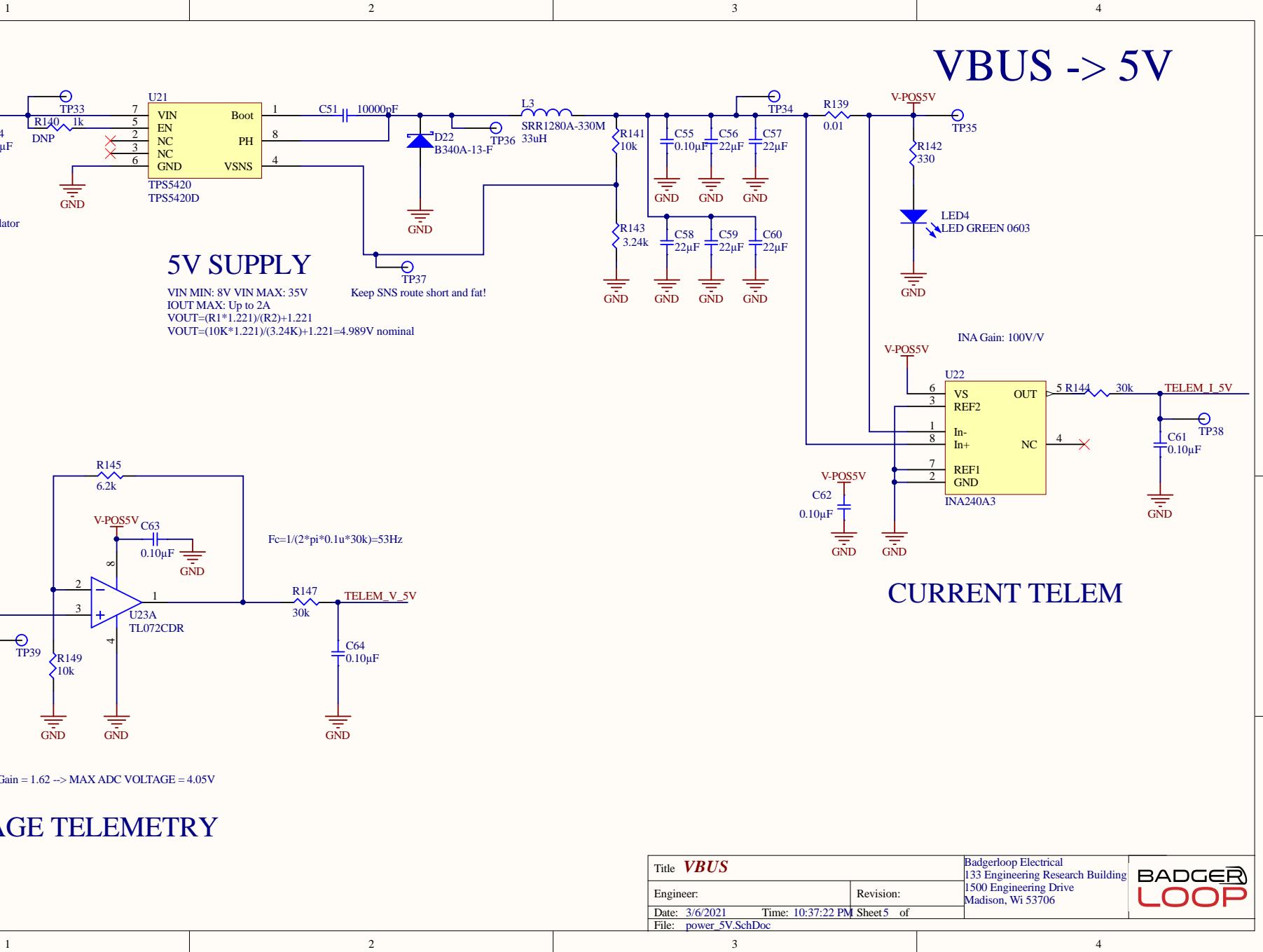
Title Bus Filter		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706	BADGER LOOP
Engineer:	Revision:		
Date: 3/6/2021 Time: 10:37:21 PM Sheet 4 of			
File: bus_filter.SchDoc			

1

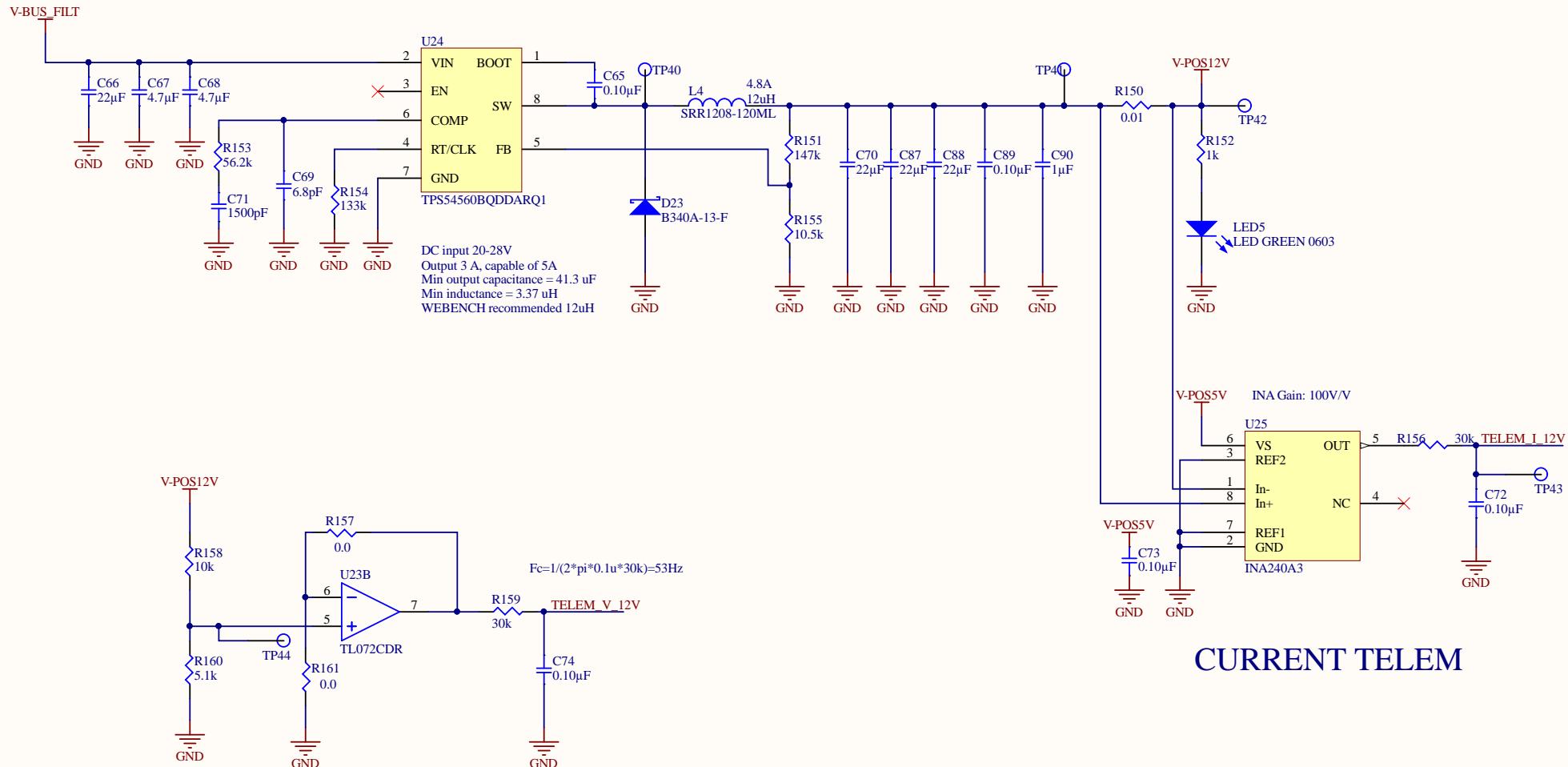
2

3

4



VBUS -> 12V



VOLTAGE TELEMETRY

Title 12V PWR		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/6/2021 Time: 10:37:22 PM Sheet 6 of		
File: power_12V.SchDoc		BADGER LOOP

1

2

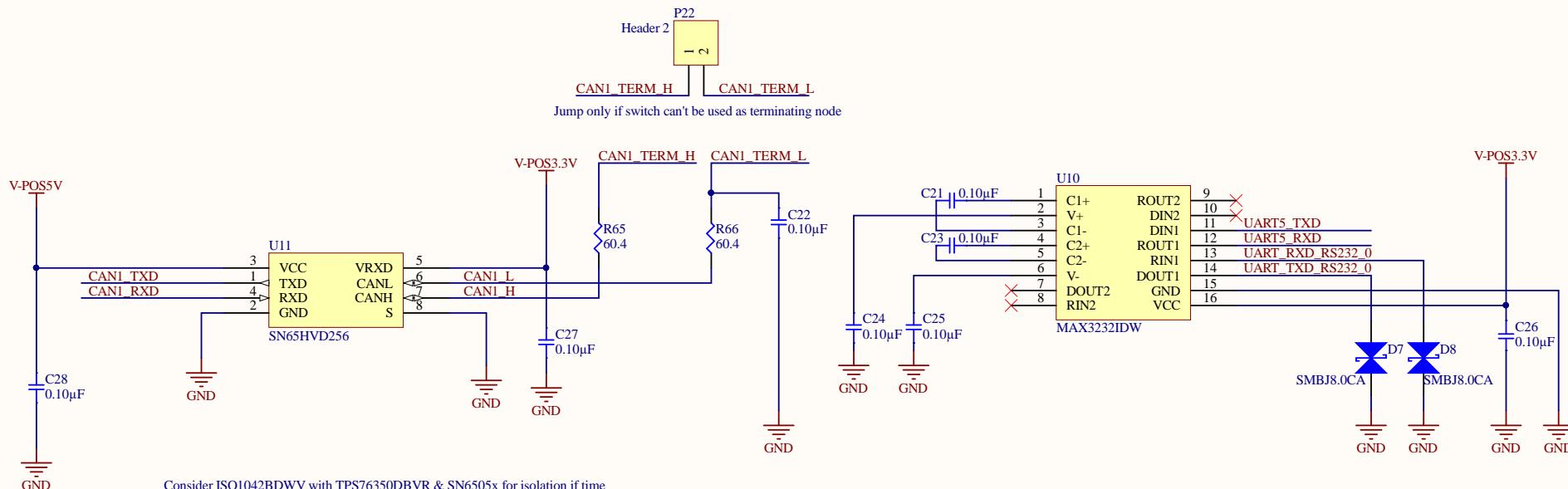
3

4

CAN**UART (x2)**

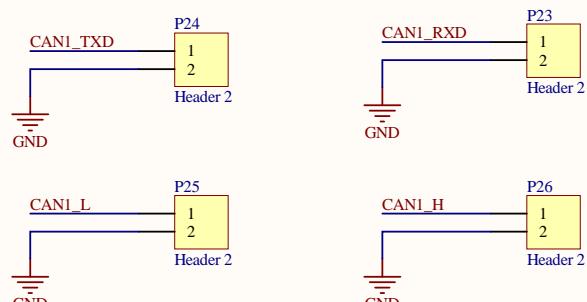
A

A



B

B



C

C

Title CAN and UART Interfaces		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/6/2021	Time: 10:37:22 PM	Sheet 7 of
File: can_uart.SchDoc		BADGER LOOP

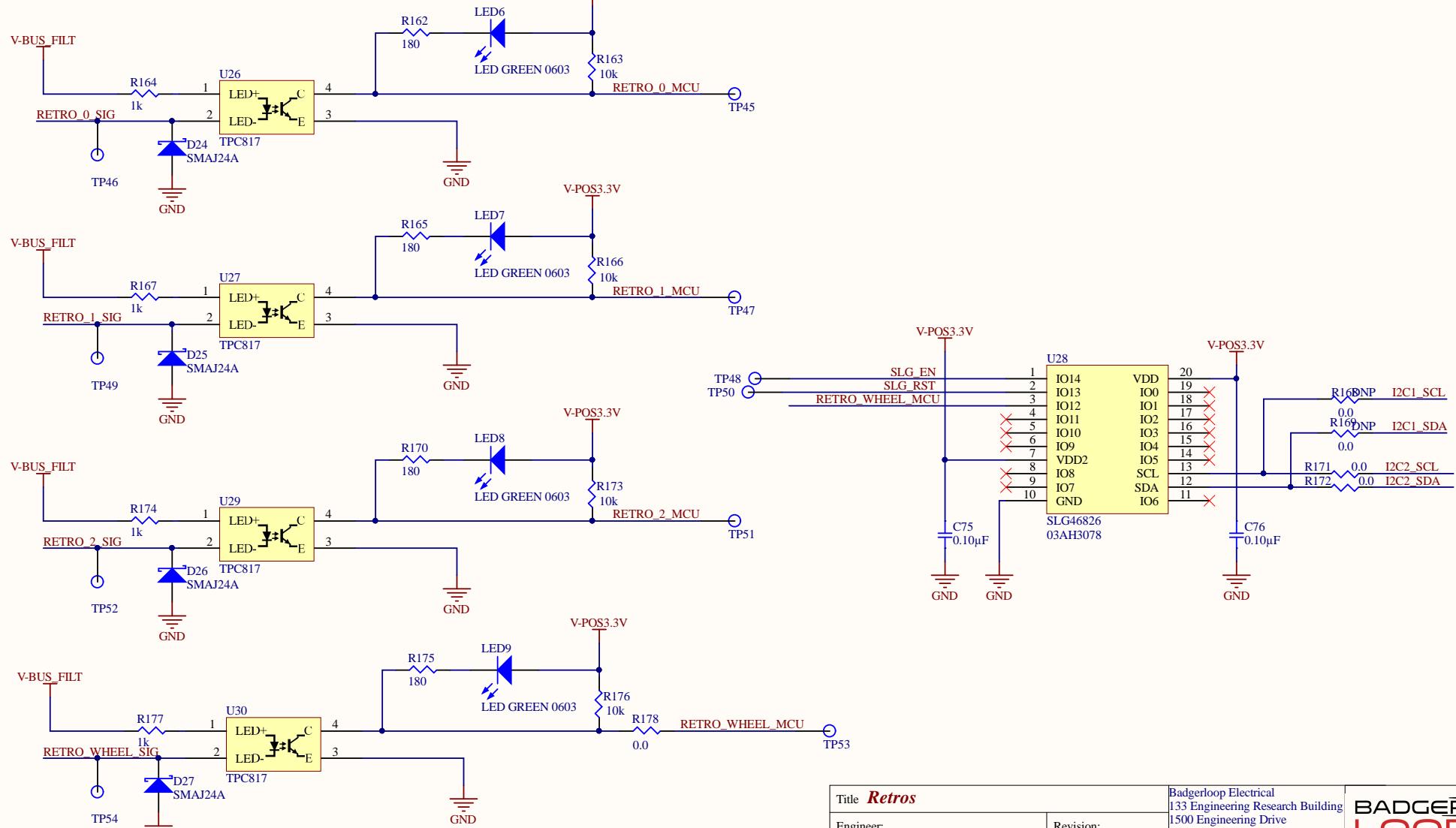
1

2

3

4

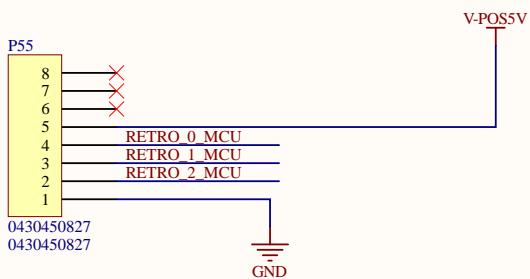
Retros & Non-driven Wheel Sensor



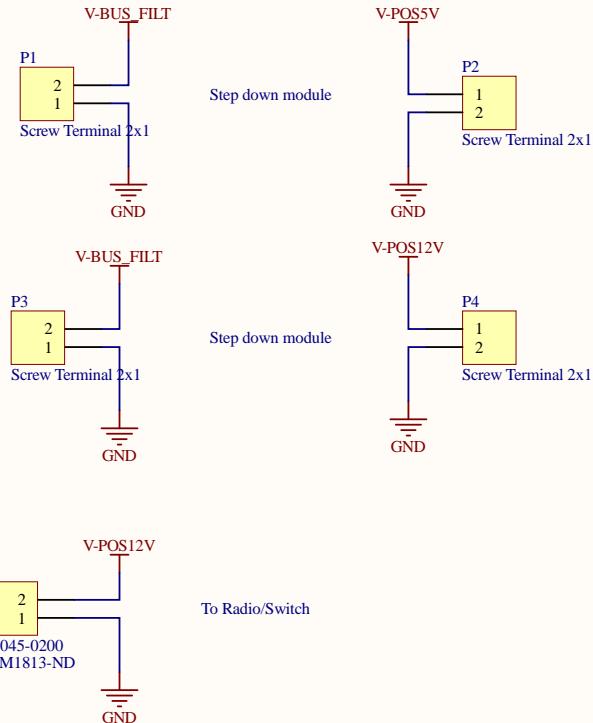
Title Retros		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/6/2021	Time: 10:37:22 PM	Sheet 8 of
File: retros.SchDoc		BADGER LOOP

Arduino Interface

Only if SX still requires this

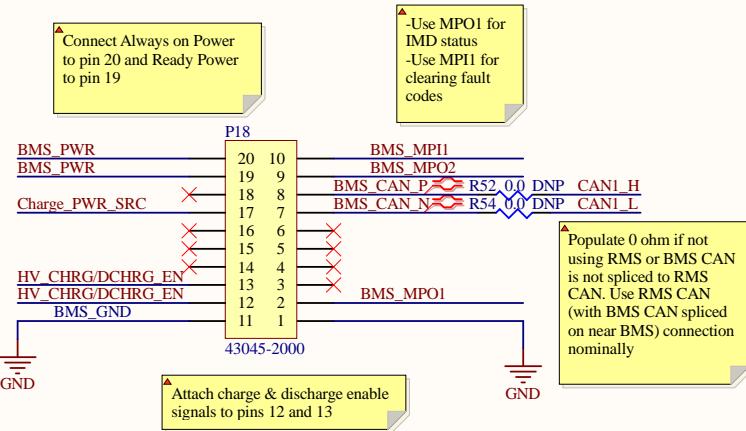


OTS Device Connections

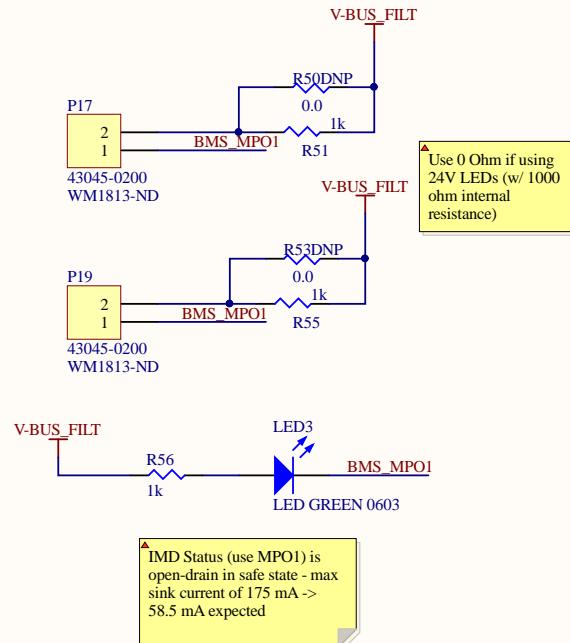


BMS Interface

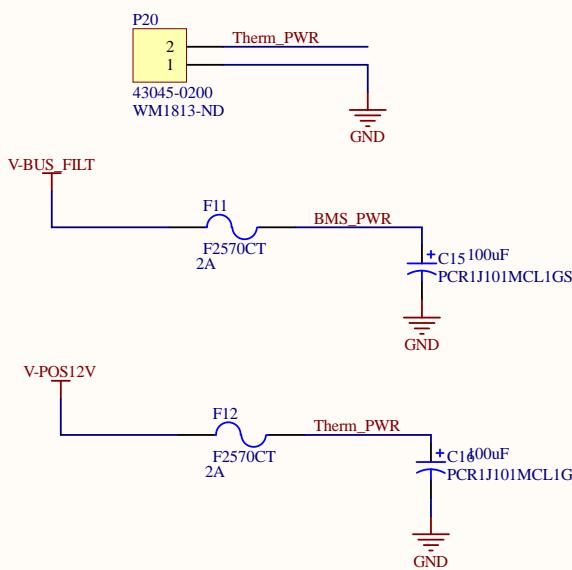
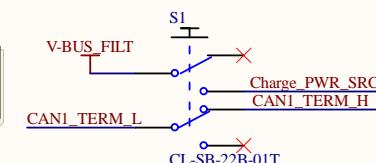
BMS/Therm Main Connectors



IMD Light circuit



Charge Enable & Termination Resistors

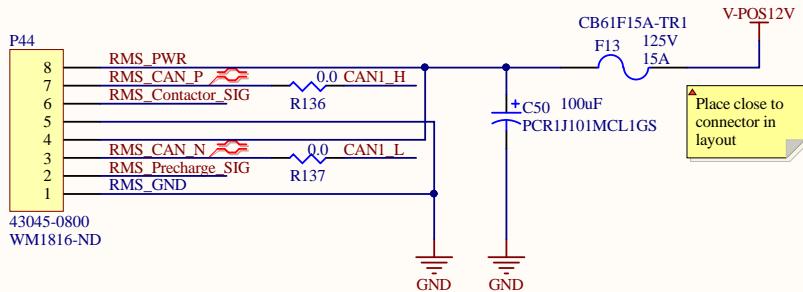


Title BMS Interface		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer: Shelby Riggelman	Revision:A	
Date: 3/6/2021	Time: 10:37:23 PM	Sheet 10 of
File: bms_interface.SchDoc		BADGER LOOP

A

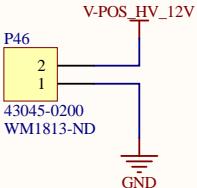
A

Motor Controller Interface



B

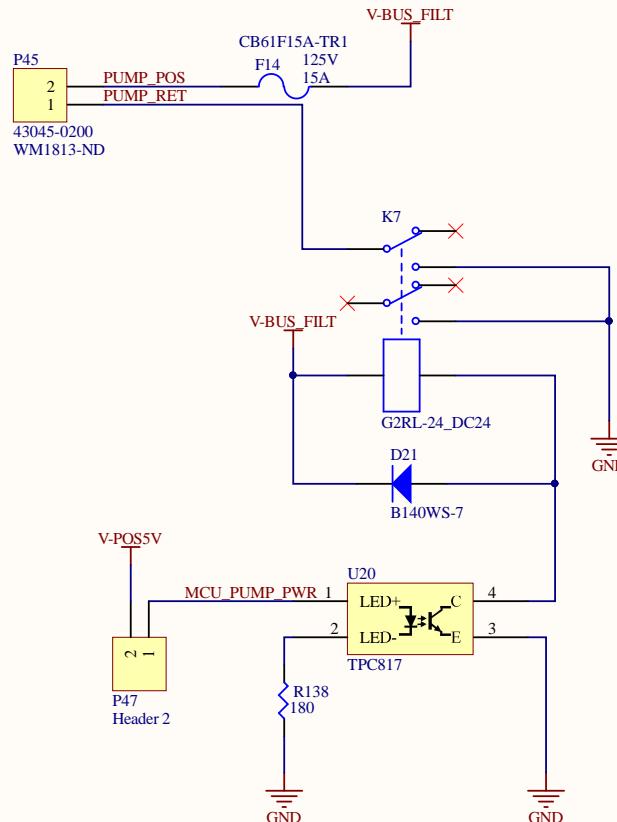
B



C

C

Pump Power



D

D

Title **RMS & Precharge Interface**

Engineer: Shelby Riggleman

Date: 3/6/2021 Time: 10:37:23 PM

File: motor_controller_interface.SchDoc

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

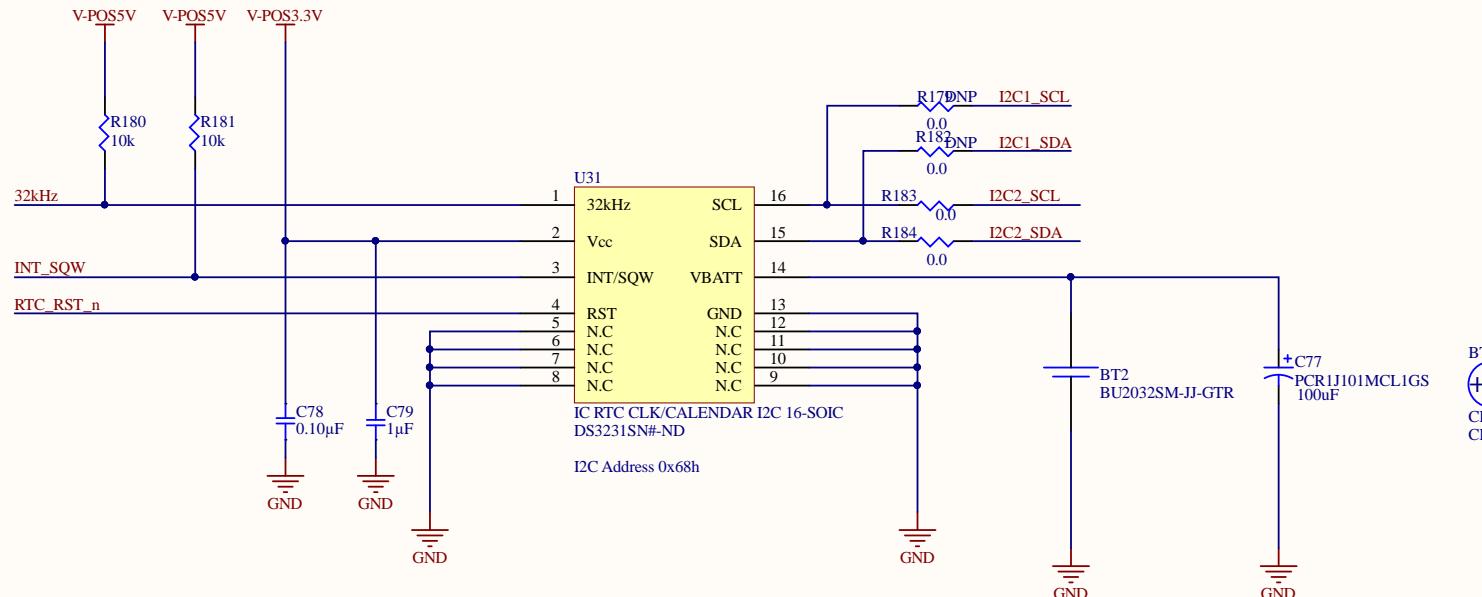


Real Time Clock & Coin Cell

A

A

Function determined by INTCN bit in OEh - SQW if 0, Active low interrupt if 1 and alarm enabled
Default = interrupt, but alarm is disabled



B

B

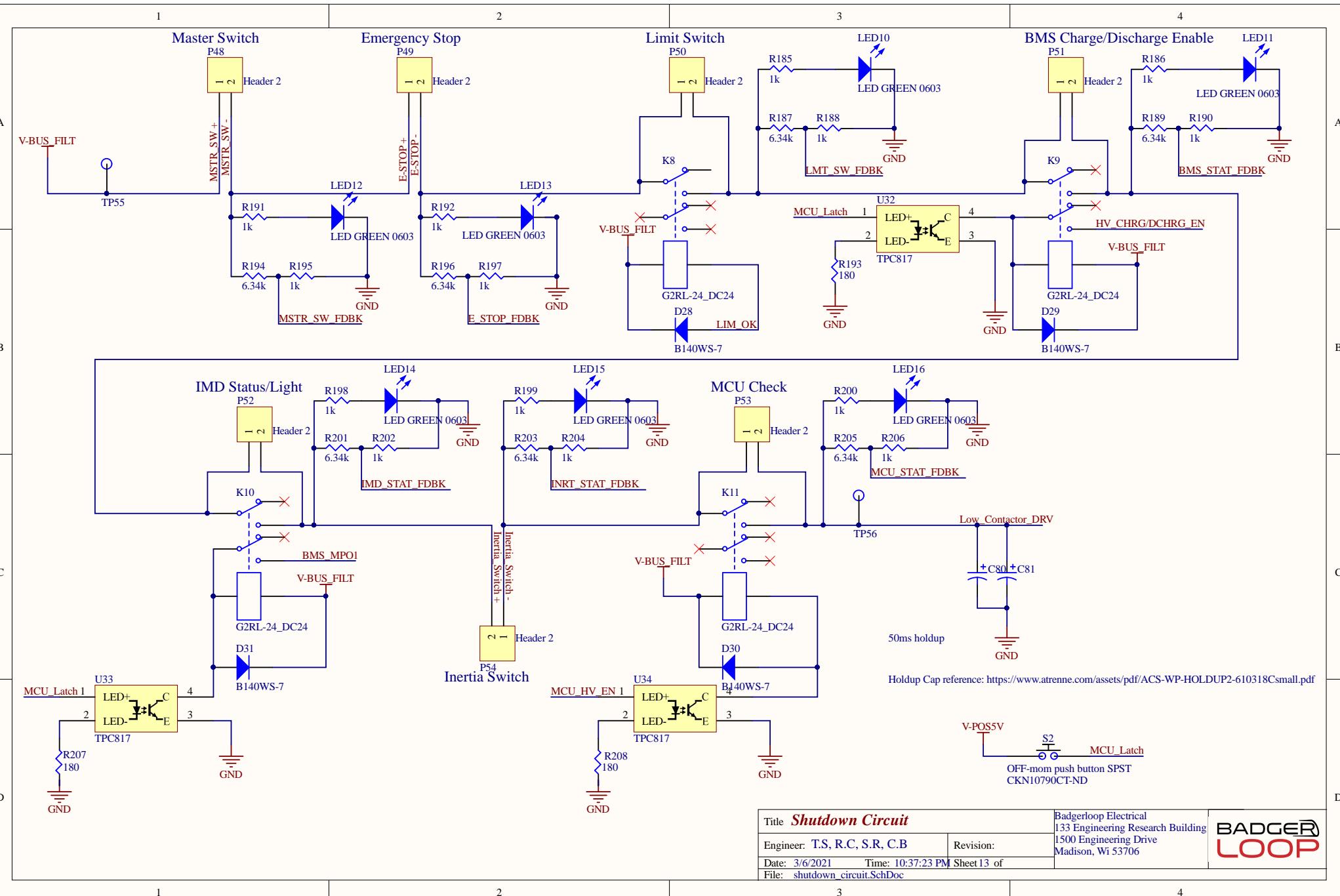
C

C

D

D

Title RTC			<i>Badgerloop 133 Engineering Research Building Madison, WI 53715</i>
Size: A4	Number:	Revision:	BADGER LOOP
Date: 3/6/2021	Time: 10:37:23 PM	Sheet 12 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\RTC.SchDoc			

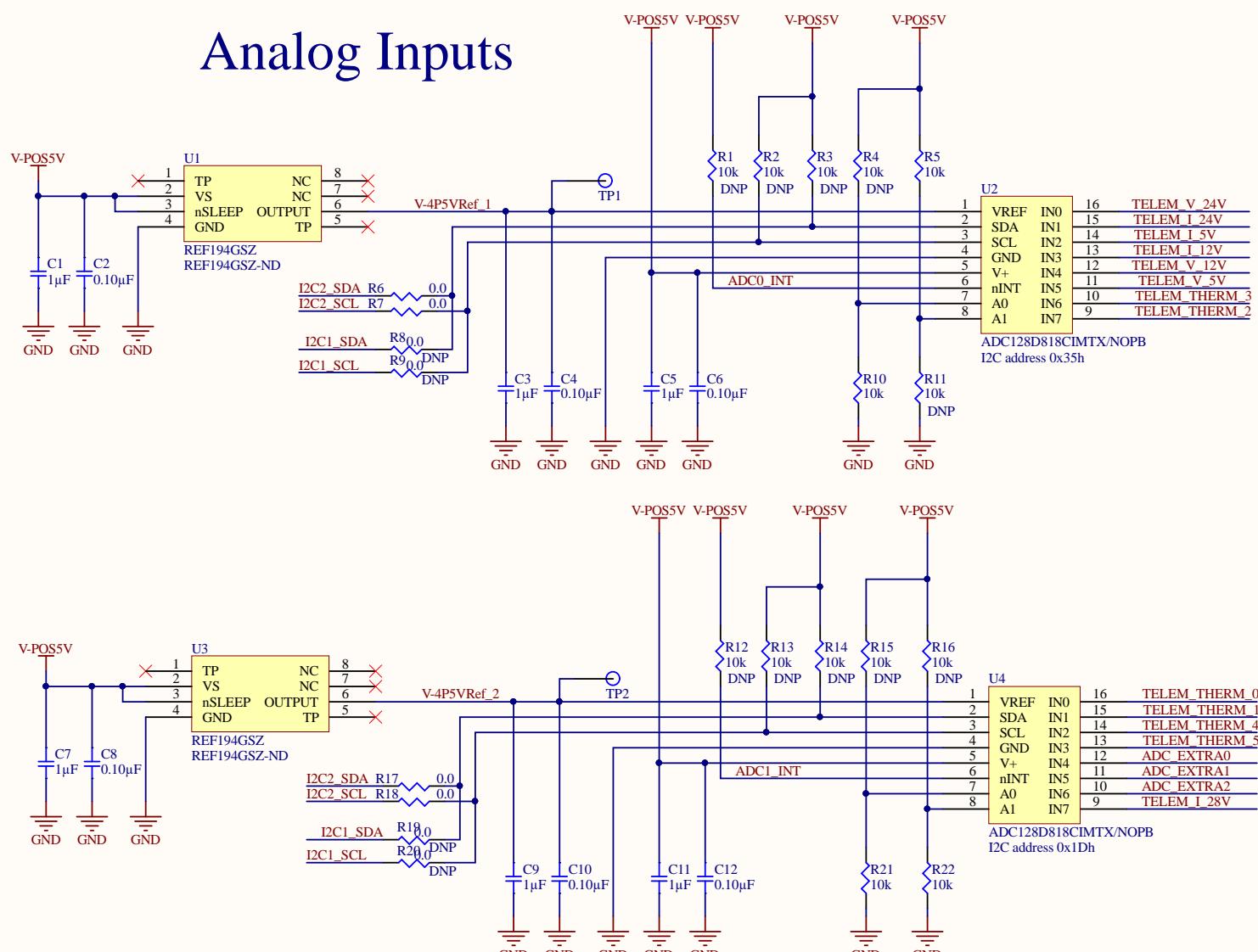


Title *Shutdown Circuit*

Engineer: T.S, R.C, S.R, C.B	Revision:
Date: 3/6/2021	Time: 10:37:23 PM Sheet 13 of
File: shutdown_circuit.SchDoc	

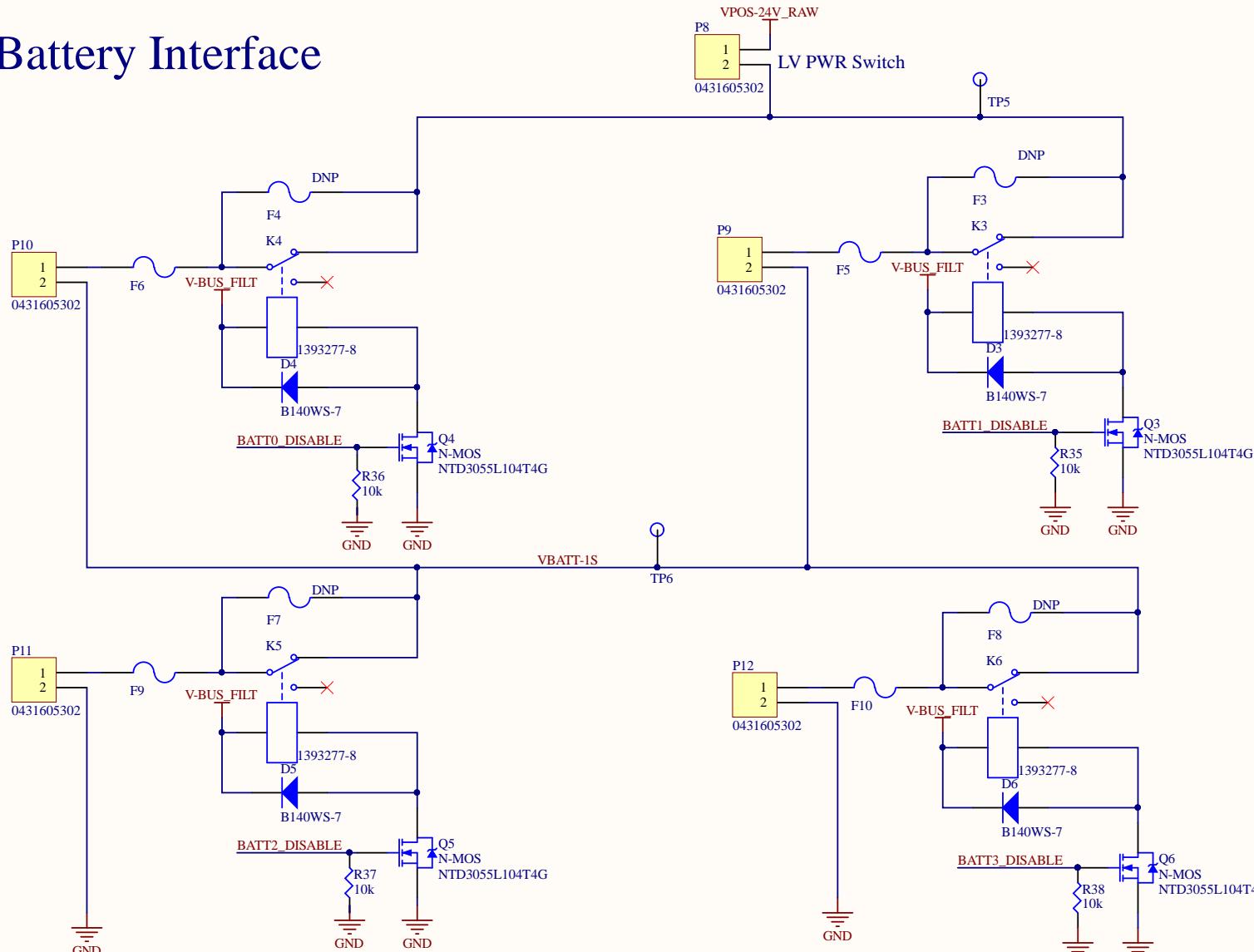
BADGER LOOP

Analog Inputs



Title ADC			<i>Badgerloop 133 Engineering Research Building Madison, WI 53715</i>
Size: A4	Number:	Revision:	
Date: 3/6/2021	Time: 10:37:23 PM	Sheet 14 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\adc.SchDoc			

LV Battery Interface



Title LV Battery Interface			Badgerloop 133 Engineering Research Building Madison, WI 53715	BADGER LOOP
Size: A4	Number:	Revision:		
Date: 3/6/2021	Time: 10:37:24 PM	Sheet 15 of		
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\battery_interface.SchDoc				

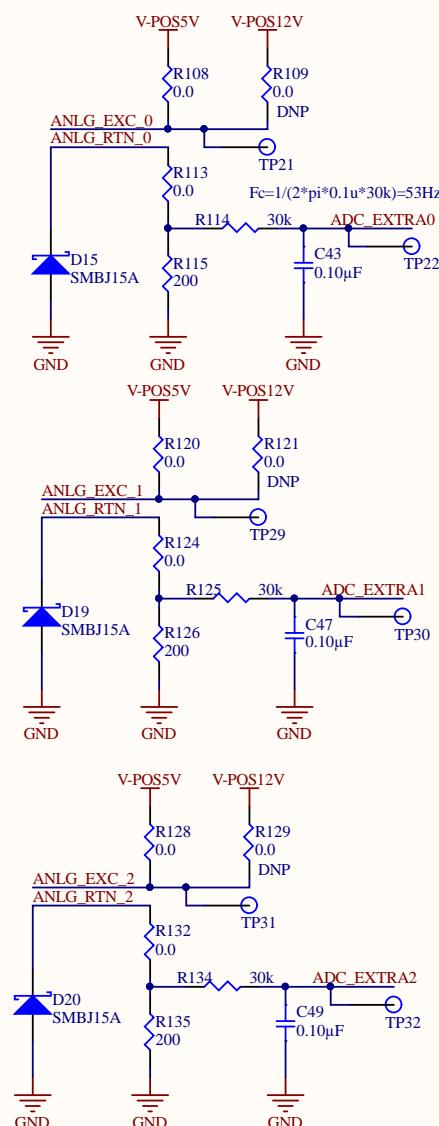
1

2

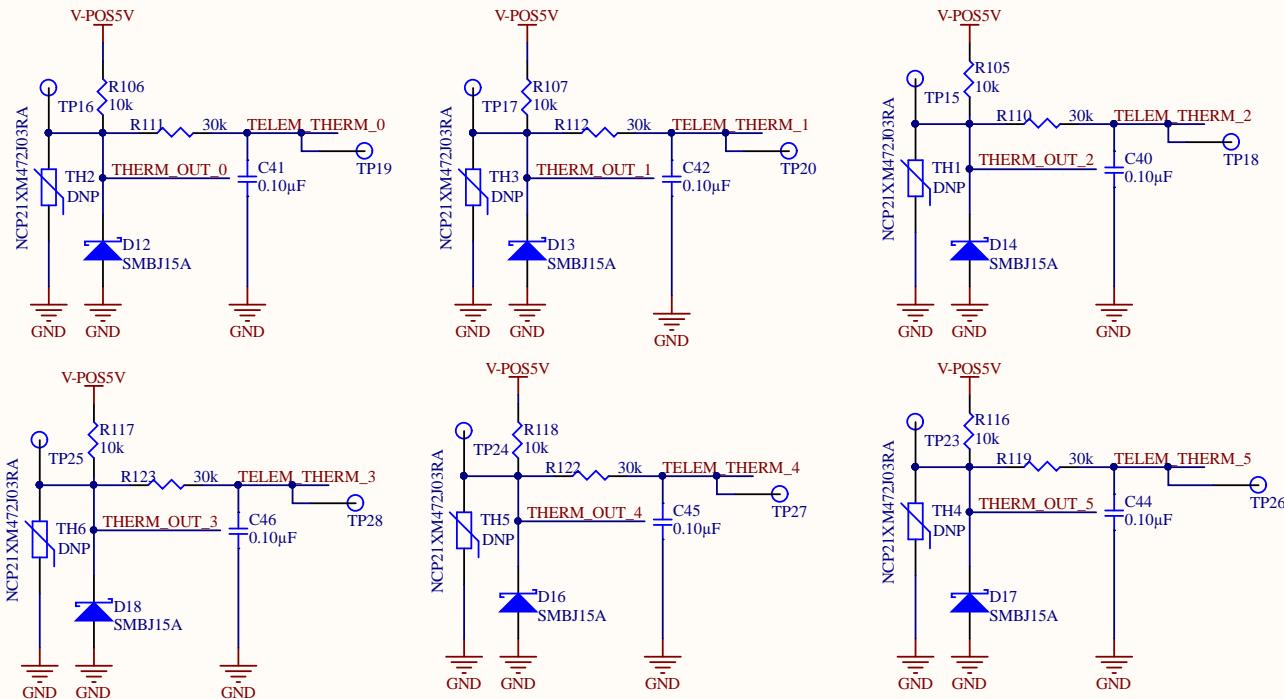
3

4

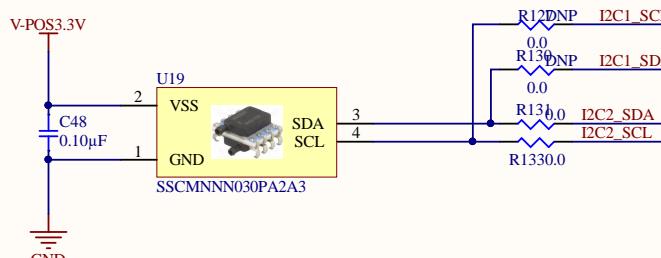
Extra Analog Sensors



Thermistors



Ambient Pressure Sensor



Title: Sensors	Badgerloop 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:
Date: 3/6/2021	Revision:
Time: 10:37:24 PM	Sheet 16 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\misc_sensors.SchDoc	

1

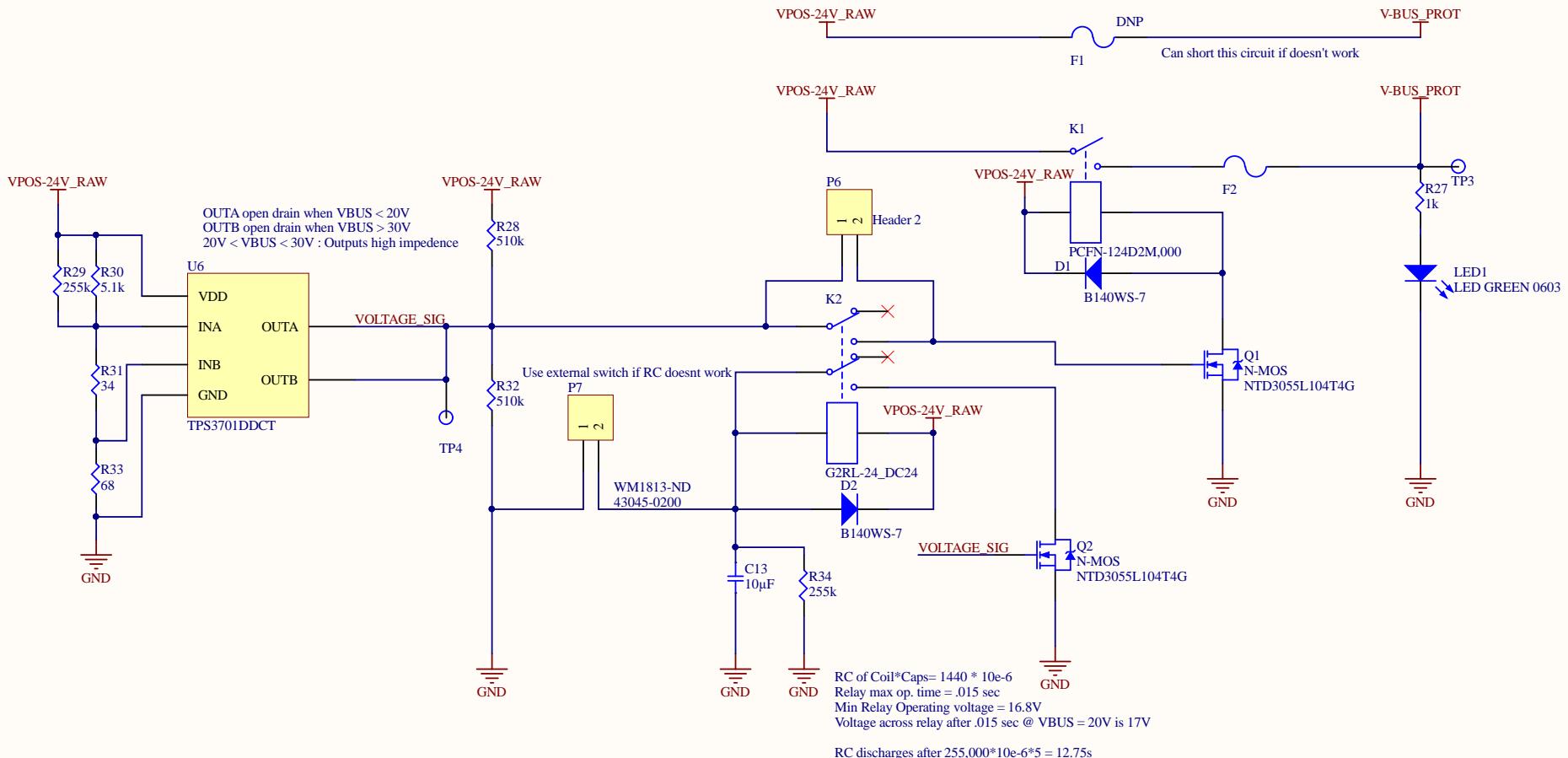
2

3

4

BADGER
LOOP

BATTERY PROTECTION



Title Battery Protection			Badgerloop 133 Engineering Research Building Madison, WI 53715	BADGER LOOP
Size: A4	Number:	Revision:		
Date: 3/6/2021	Time: 10:37:24 PM	Sheet 17 of		
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\batt_protection.SchDoc				

1

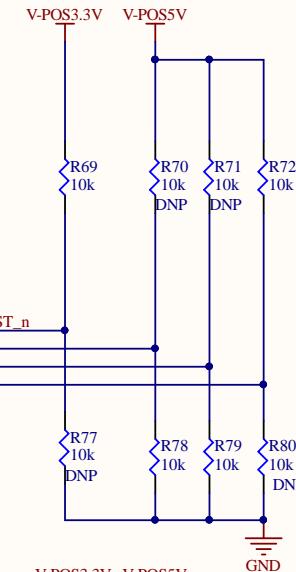
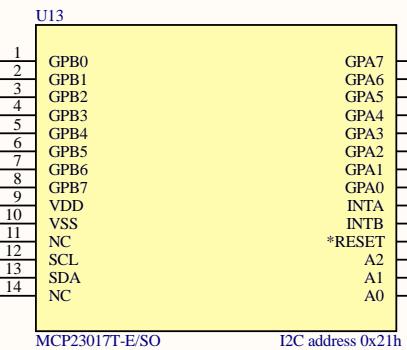
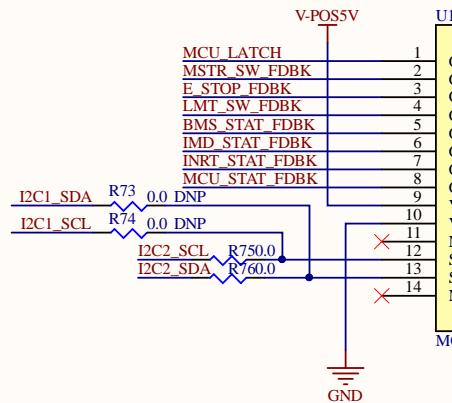
2

3

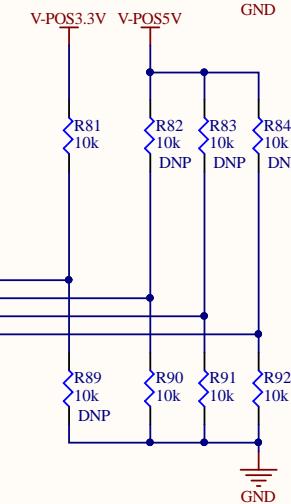
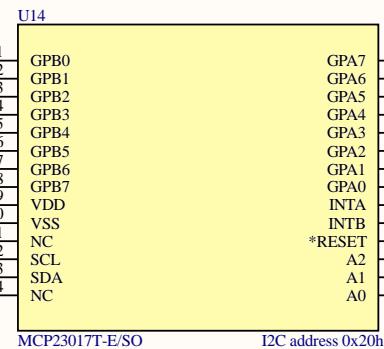
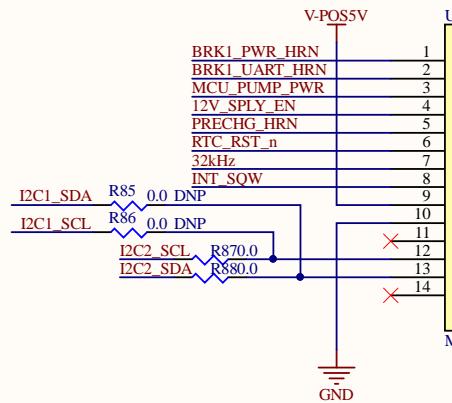
4

GPIO

A

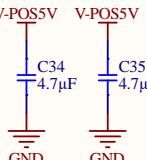


B



C

Place close to U?



Title: GPIO	Badgerloop
Size: A4	Number:
Date: 3/6/2021	Revision:
Time: 10:37:24 PM	Sheet 18 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\gpio.SchDoc	BADGER LOOP

1

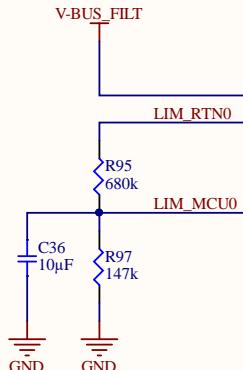
2

3

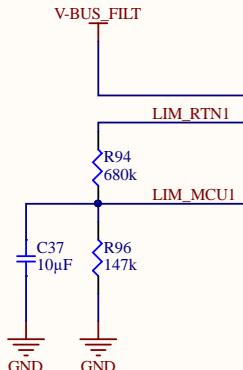
4

Limit Switch Feedback

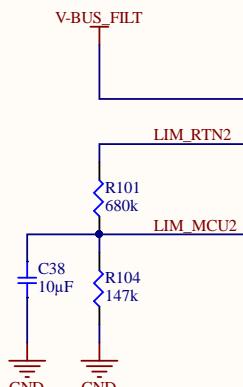
A



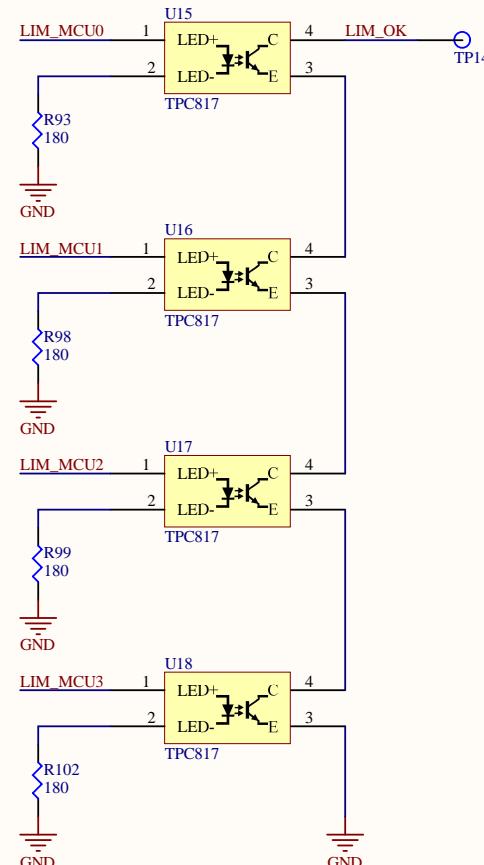
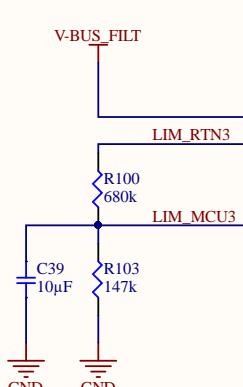
B



C

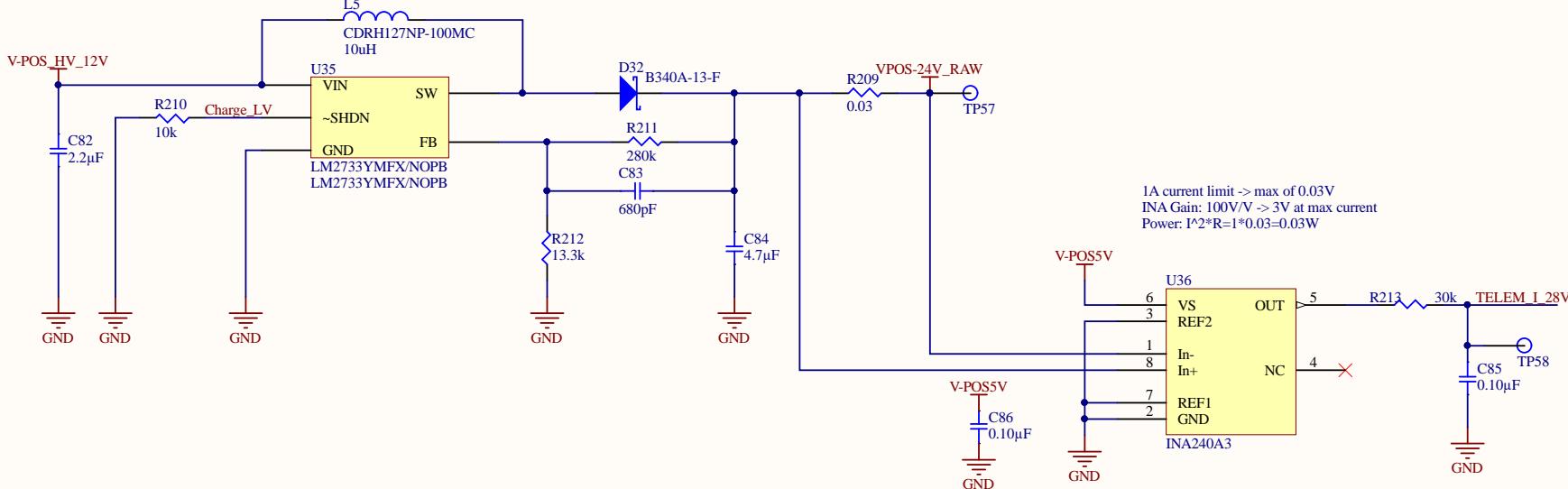


D



Title: Limit Switches	Badgerloop 133 Engineering Research Building Madison, WI 53715	BADGER LOOP
Size: A4	Number:	Revision:
Date: 3/6/2021	Time: 10:37:25 PM	Sheet 19 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\limit_switches.SchDoc		

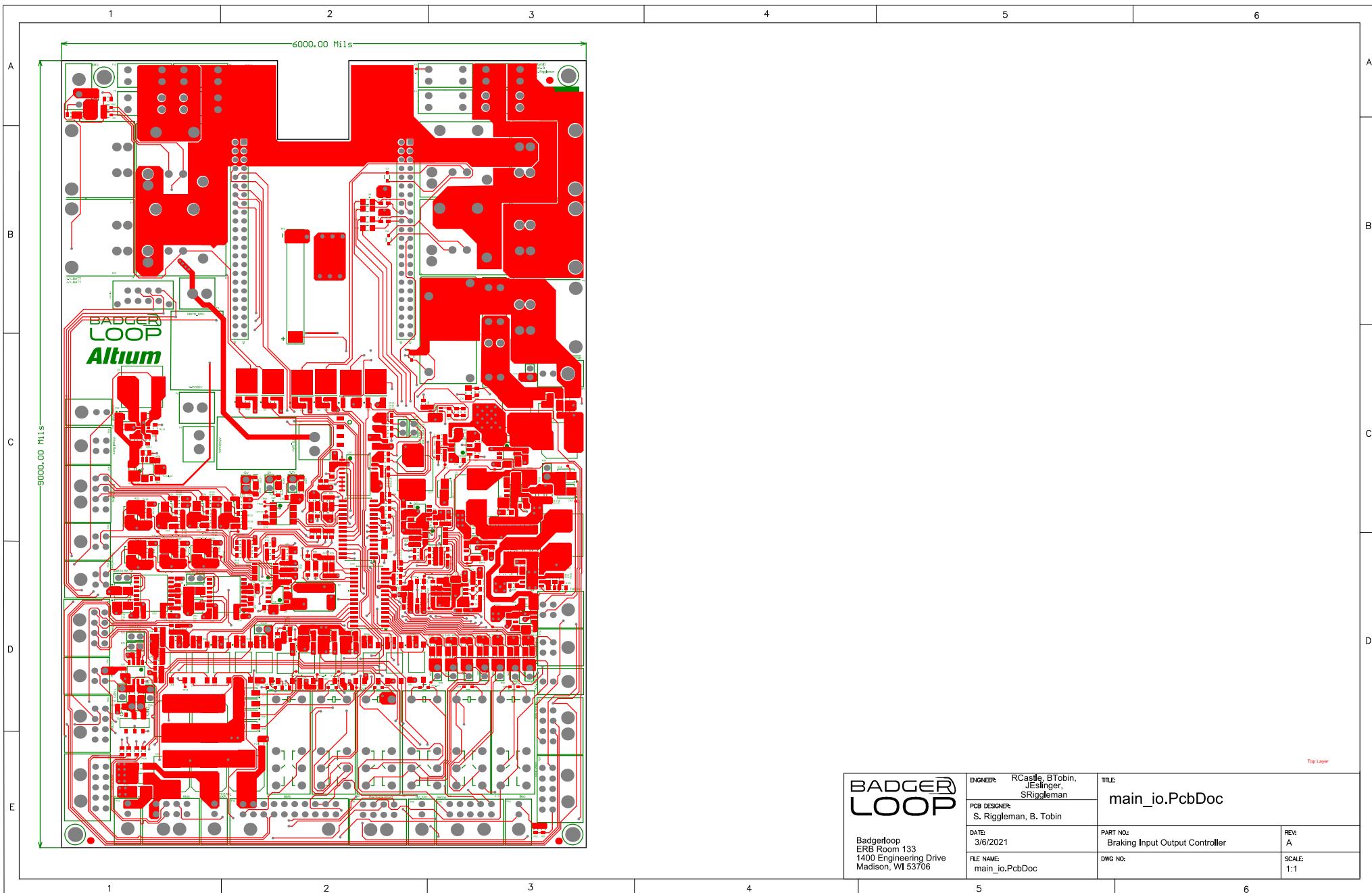
HV Batt 12V -> 28V

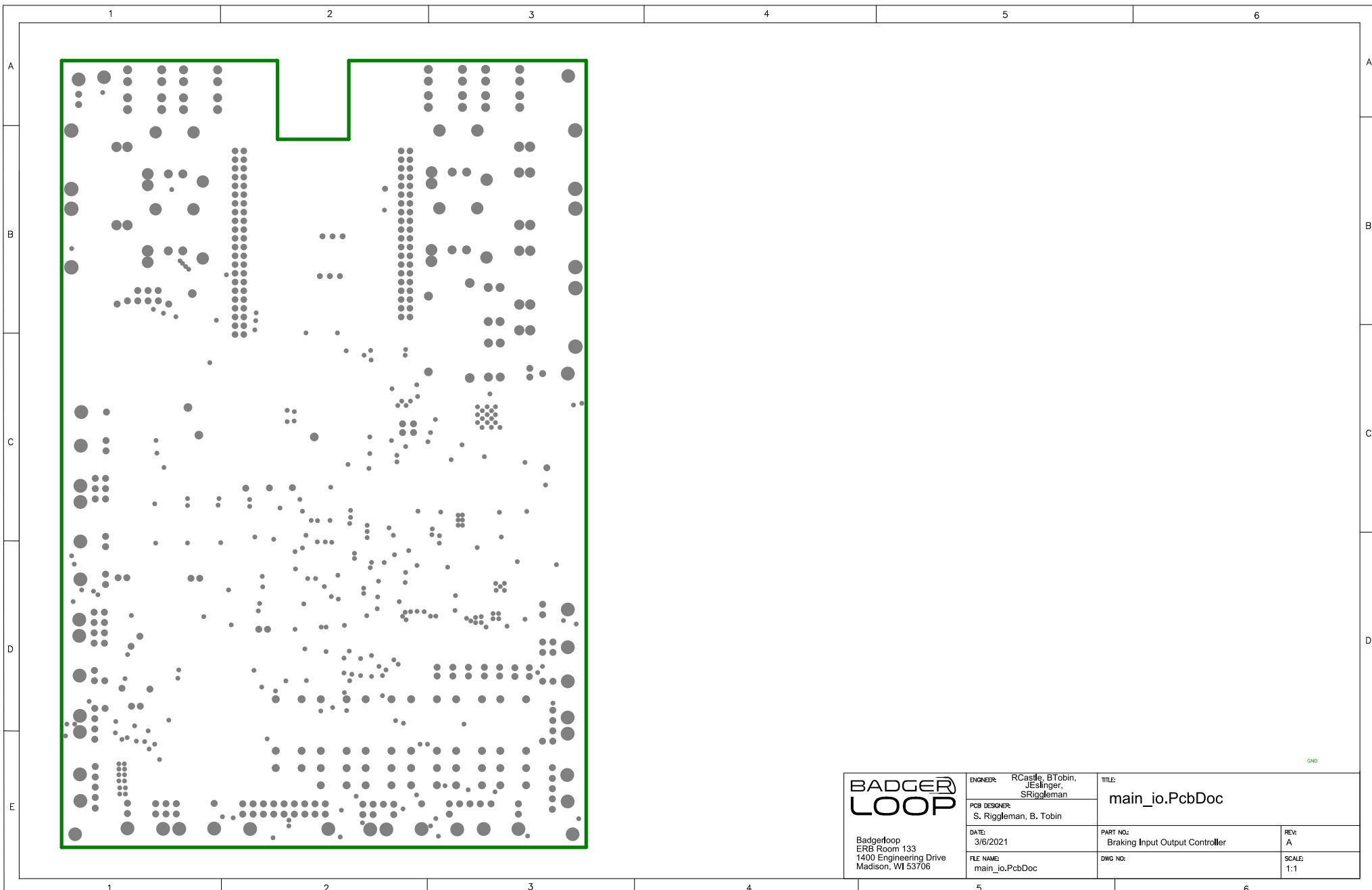


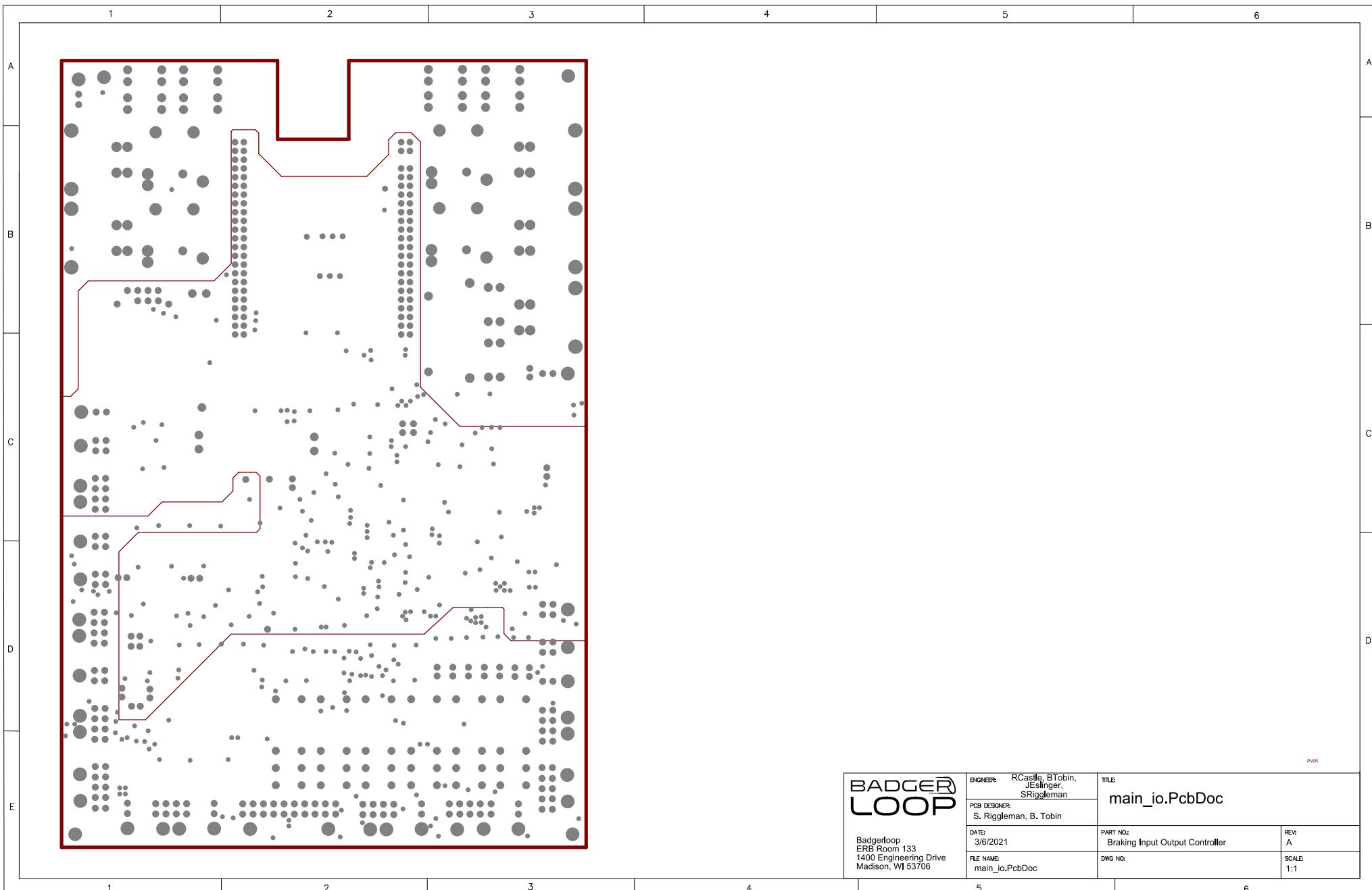
CURRENT TELEM

Title 28V Boost	Badgerloop
Size: A4	Number:
Date: 3/6/2021	Revision:
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\power_28V.SchDoc	133 Engineering Research Building Madison, WI 53715

BADGER LOOP







BADGER LOOP		ENGINEER: RCasile, BTobin, JEslinger, SRiggleman	TITLE: main_io.PcbDoc	
PCB DESIGNER: S. Riggleman, B. Tobin				
DATE: 3/6/2021	PART NO: Braking Input Output Controller	REV: A		
FILE NAME: main_io.PcbDoc	DWG NO:	SCALE: 1:1		

