

A

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D

MAIN IO

POD 5

REV B

Title Main IO		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706	
Engineer:	Revision:		
Date: 3/8/2021	Time: 6:56:47 PM	Sheet 1 of 1	
File: main_io.SchDoc			

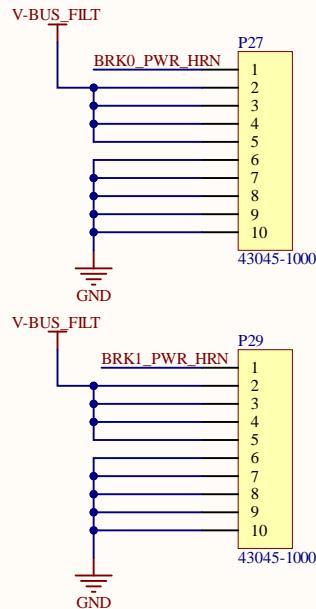
1

2

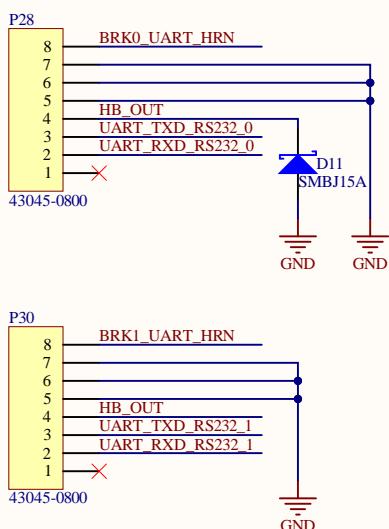
3

4

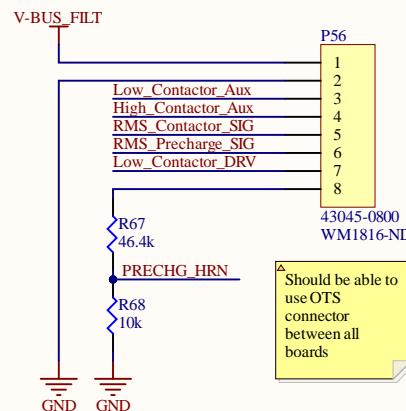
BrakingIO PWR



BrakingIO UART



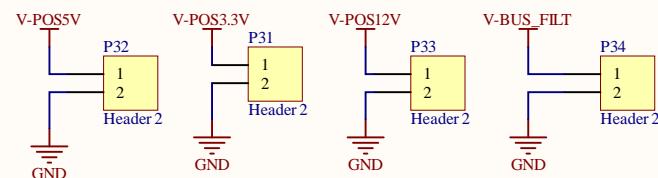
Precharge Board



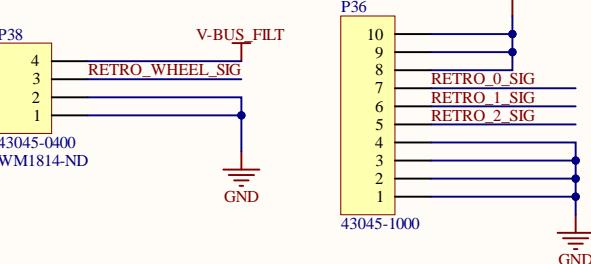
BMS & RMS

See respective schematics

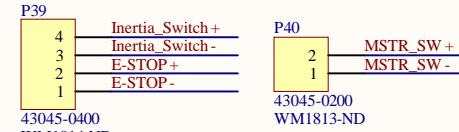
Debug



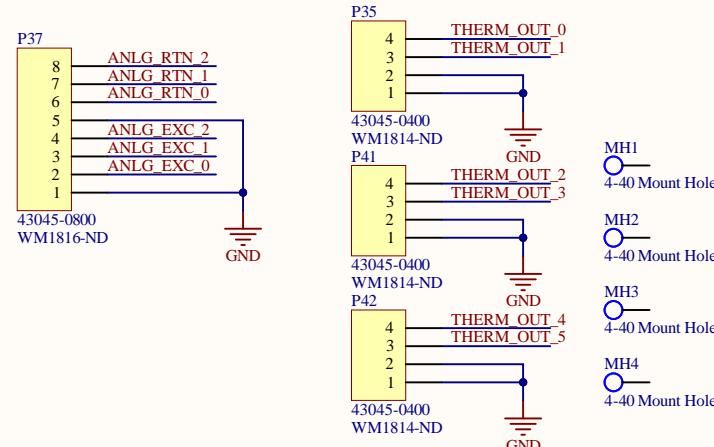
Retro Sensors



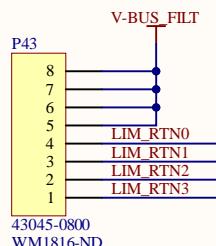
Shutdown Circuit Inputs



Analog Sensors



Limit Switches



Fiducials



Connectors

Title: Connectors

Engineer:

Date: 3/8/2021

File: connectors.SchDoc

Revision:

Time: 6:56:47 PM

Sheet 2 of

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

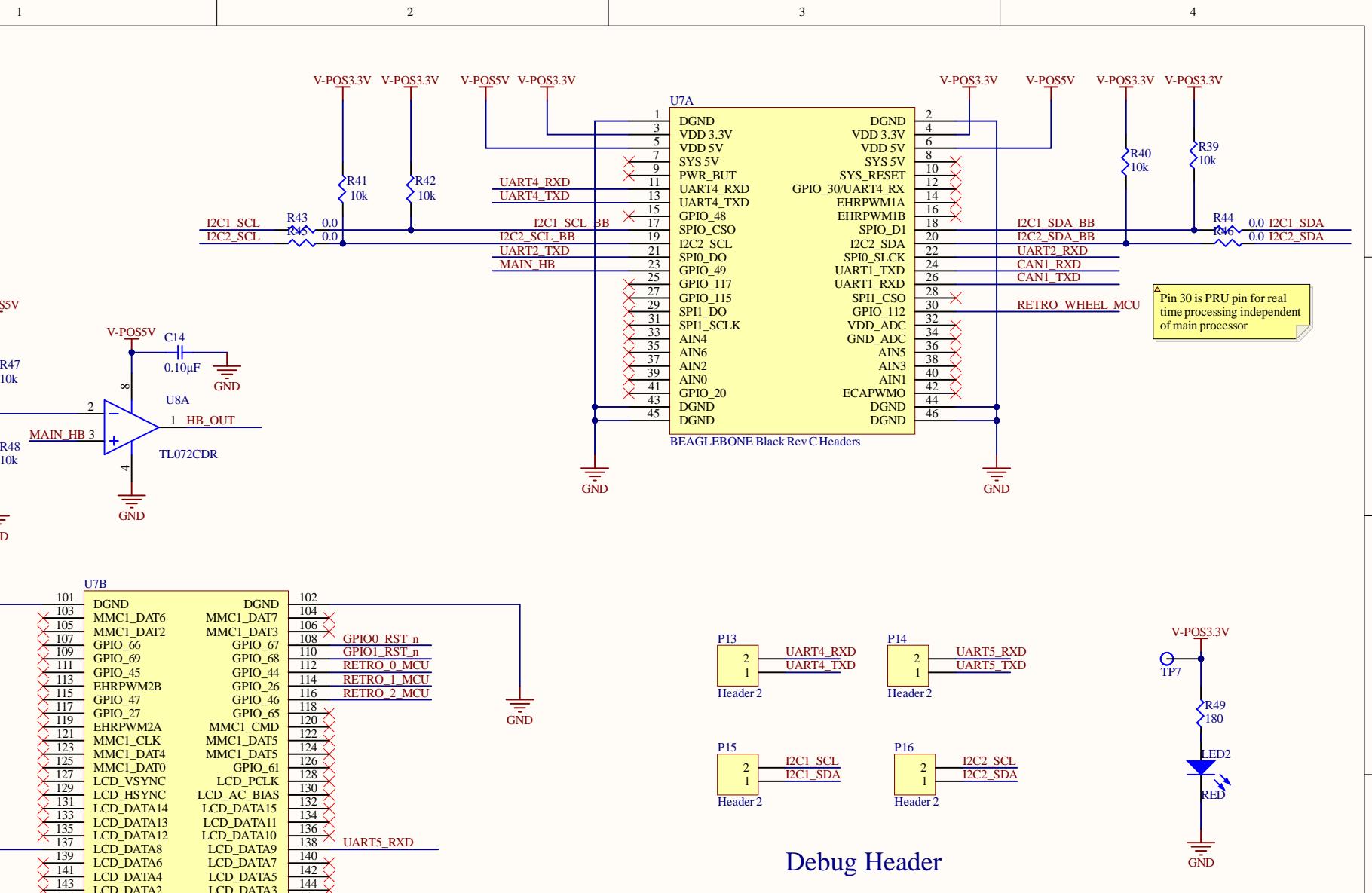
BADGER
LOOP

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Beaglebone Headers

Title Beaglebone		Badgerloop Electrical
Engineer:	Revision:	133 Engineering Research Building
Date: 3/8/2021	Time: 6:56:47 PM	1500 Engineering Drive
File: beaglebone.SchDoc		Madison, WI 53706

**BADGER
LOOP**

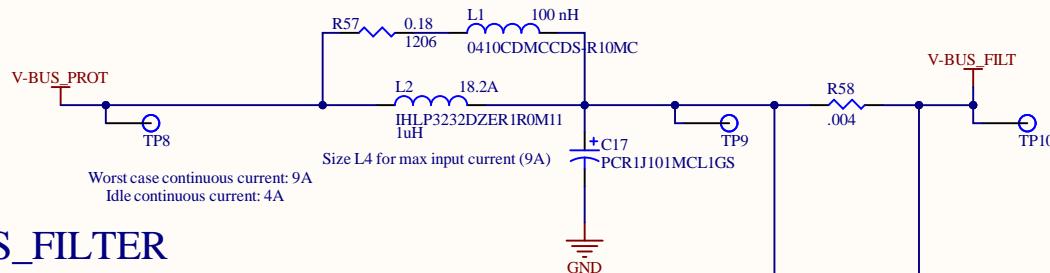
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A

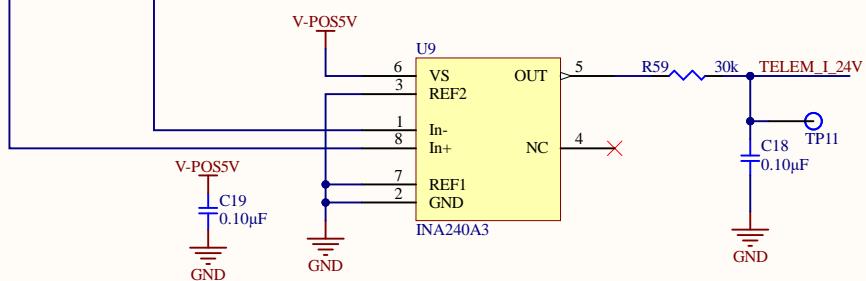


BUS_FILTER

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

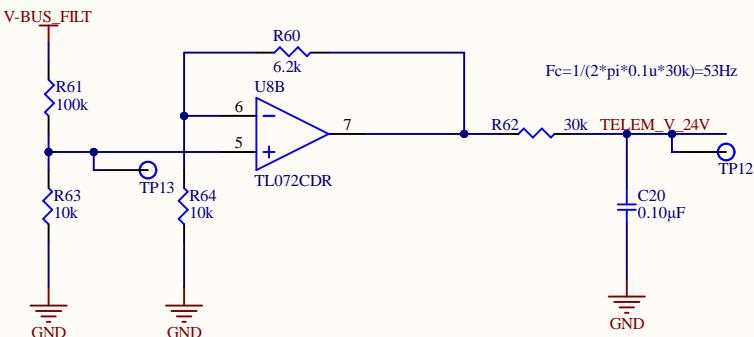
Max current draw: 9A → 9A * 0.004Ω = 0.036V
 INA Gain: 100V/V → 3.6V at Max current
 Power: $I^2 \cdot R = 81 \cdot 0.004 = 0.324W$

B



CURRENT TELEM

C



VOLTAGE TELEMETRY

BUS FILTER

Title Bus Filter		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/8/2021	Time: 6:56:47 PM	Sheet 4 of
File: bus_filter.SchDoc		BADGER LOOP

1

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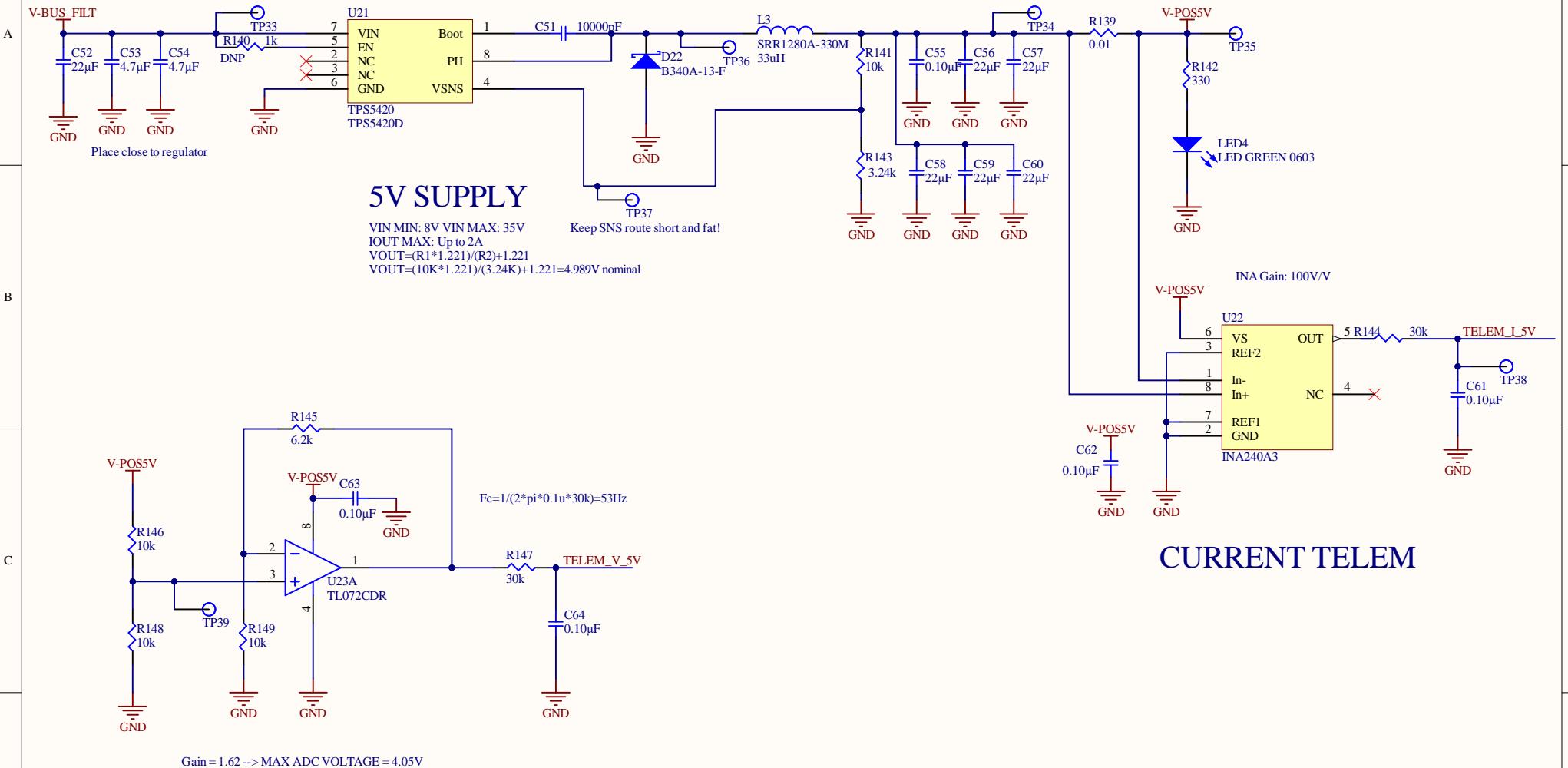
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VBUS -> 5V

Title **VBUS**

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



Engineer:

Revision:

Date: 3/8/2021

Time: 6:56:48 PM

Sheet 5 of

File: power_5V.SchDoc

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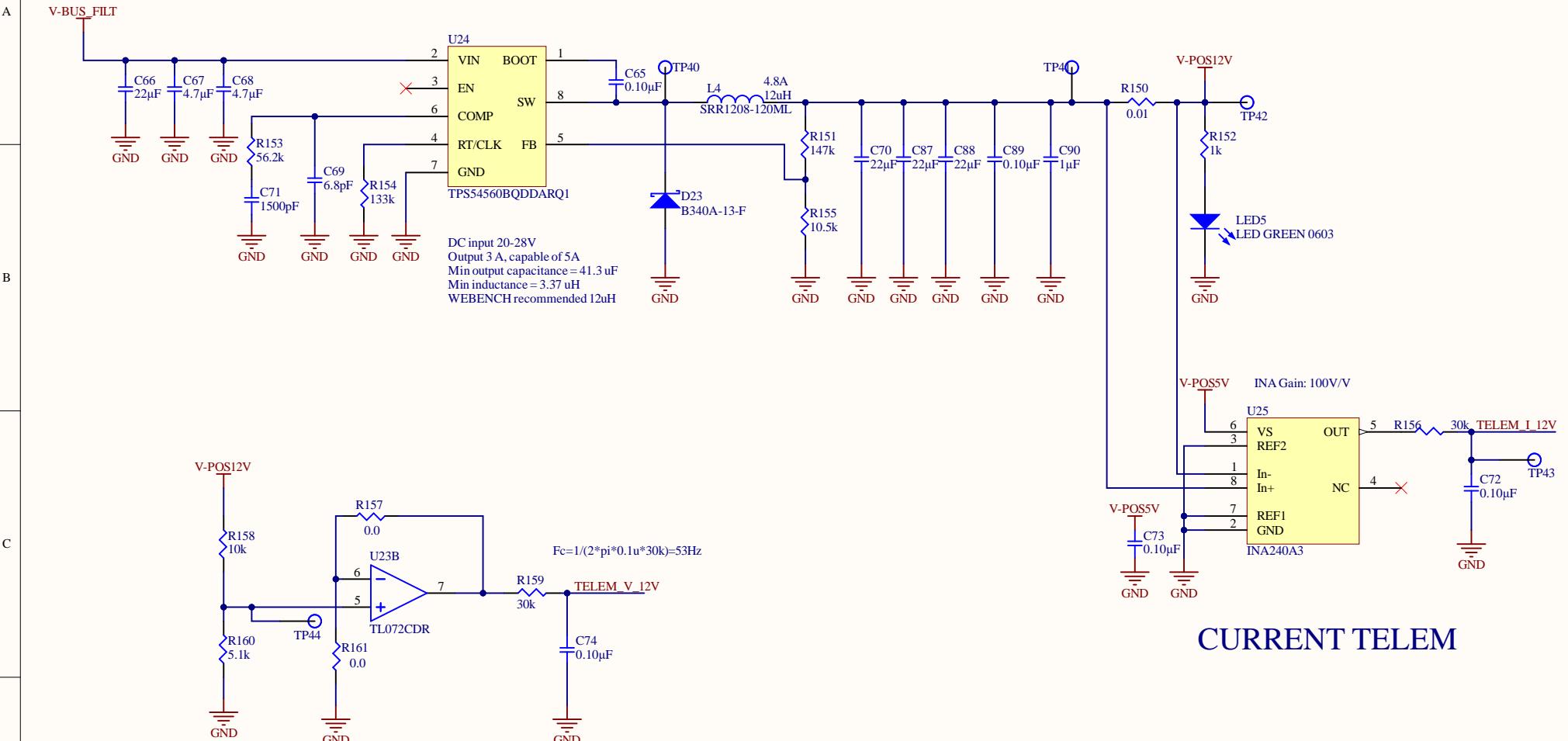
1

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VBUS -> 12V



Title 12V PWR		Badgerloop Electrical
Engineer:	Revision:	133 Engineering Research Building
Date: 3/8/2021	Time: 6:56:48 PM	1500 Engineering Drive
Sheet 6 of		Madison, WI 53706
File: power_12V.SchDoc		

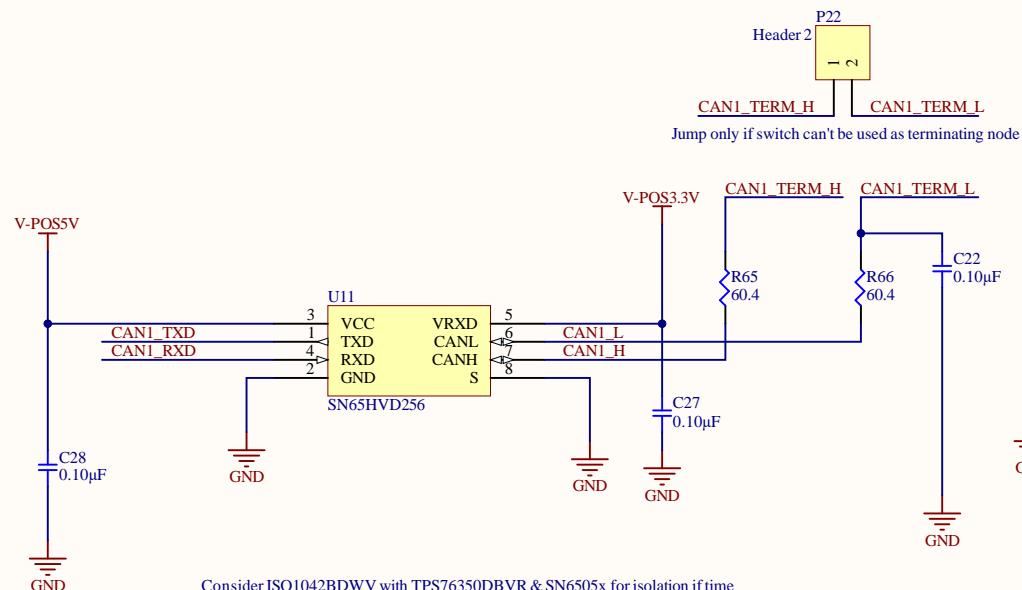
1

2

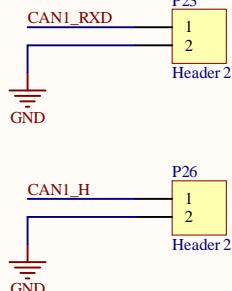
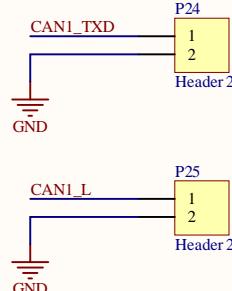
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4

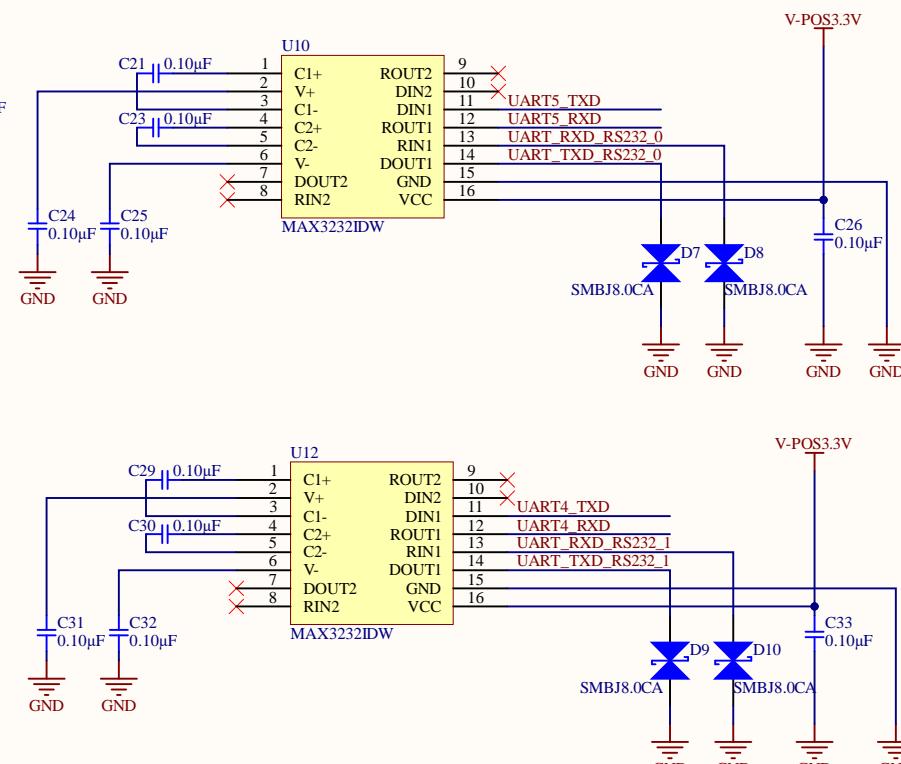
CAN



Consider ISO1042BDWV with TPS76350DBVR & SN6505x for isolation if time



UART (x2)



Title **CAN and UART Interfaces**

Engineer:

Revision:

Date: 3/8/2021

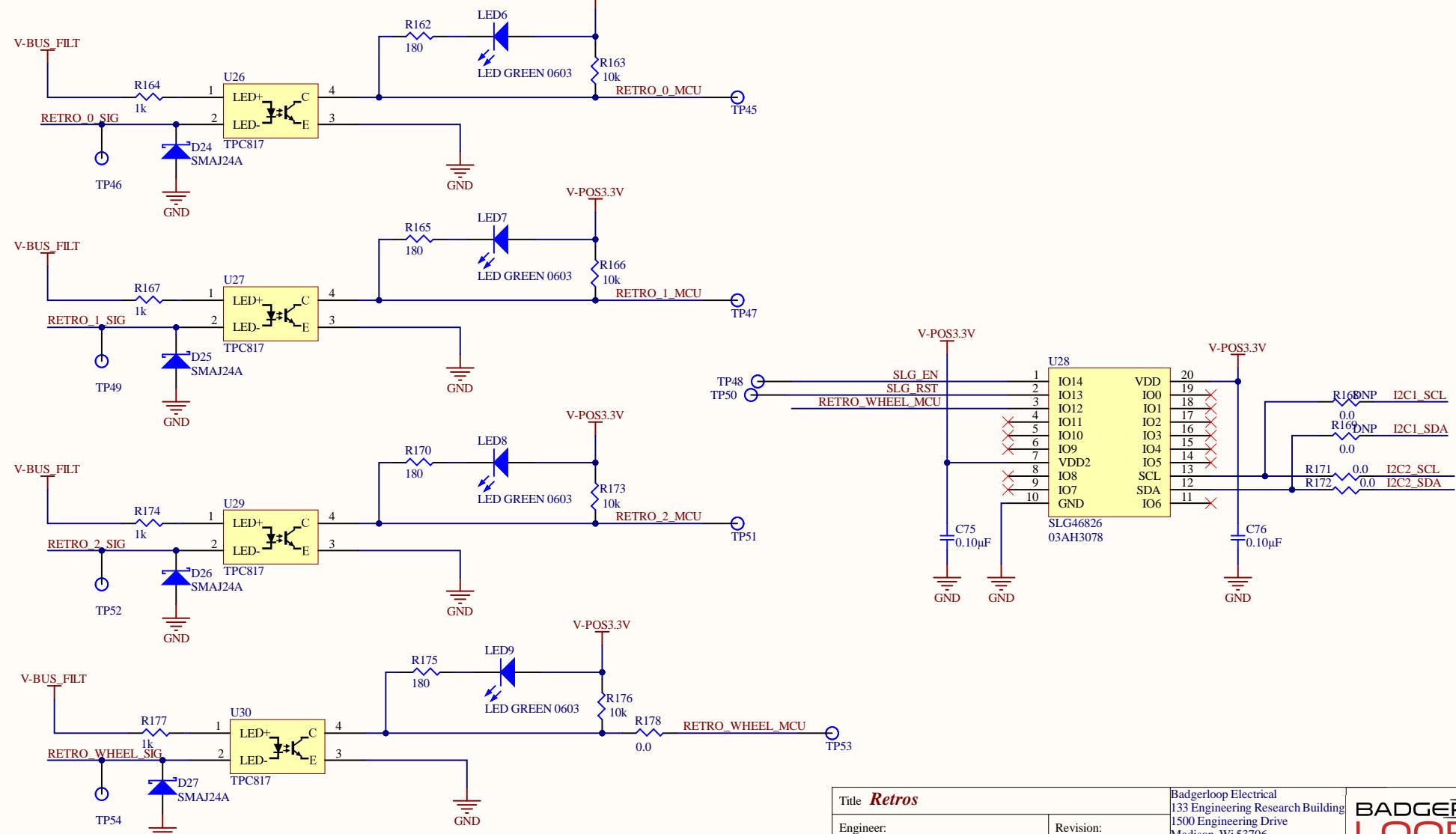
Time: 6:56:48 PM

File: can_uart.SchDoc

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



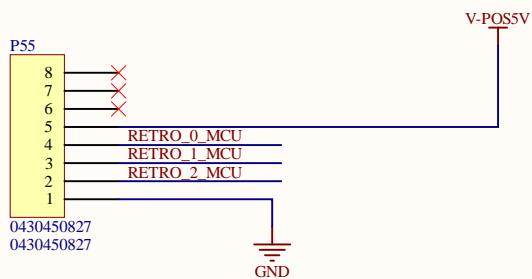
Retros & Non-driven Wheel Sensor



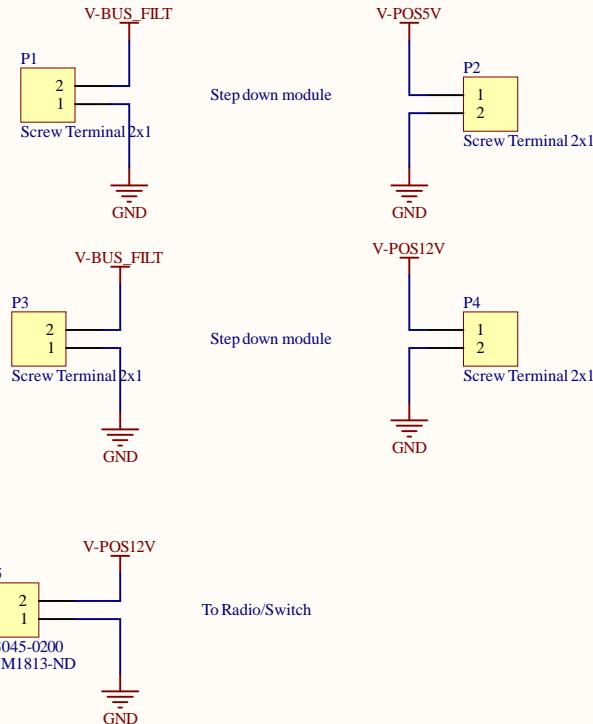
Title Retros		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, WI 53706
Engineer:	Revision:	
Date: 3/8/2021	Time: 6:56:48 PM	Sheet 8 of
File: retros.SchDoc		BADGER LOOP

Arduino Interface

Only if SX still requires this



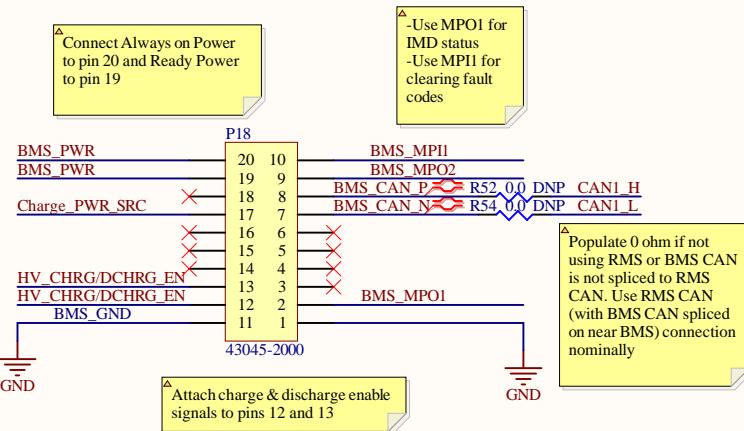
OTS Device Connections



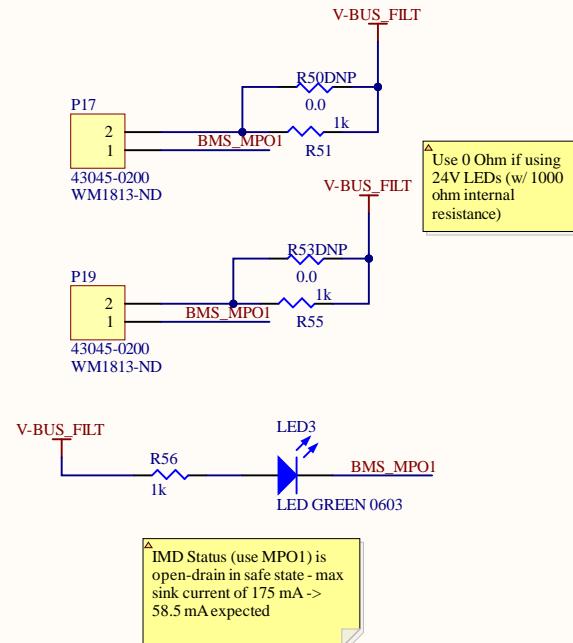
Title Arduino Shield		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/8/2021	Time: 6:56:49 PM	Sheet 9 of
File: arduino_shield.SchDoc		BADGER LOOP

BMS Interface

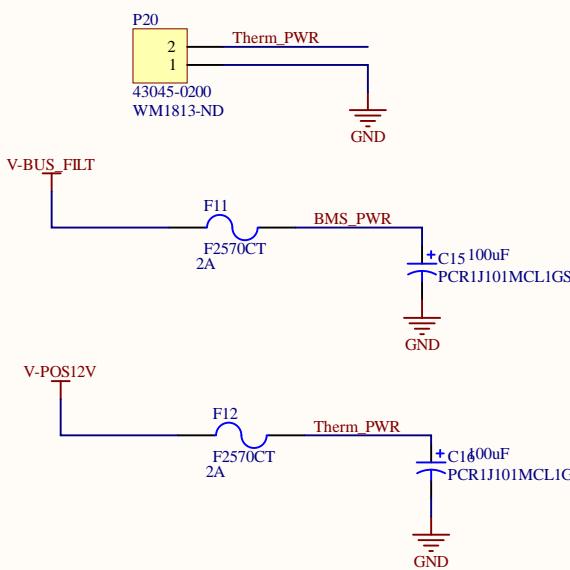
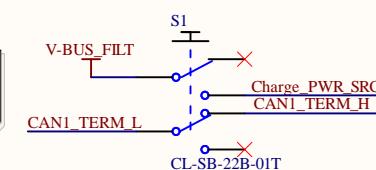
BMS/Therm Main Connectors



IMD Light circuit



Charge Enable & Termination Resistors



Charger Connector

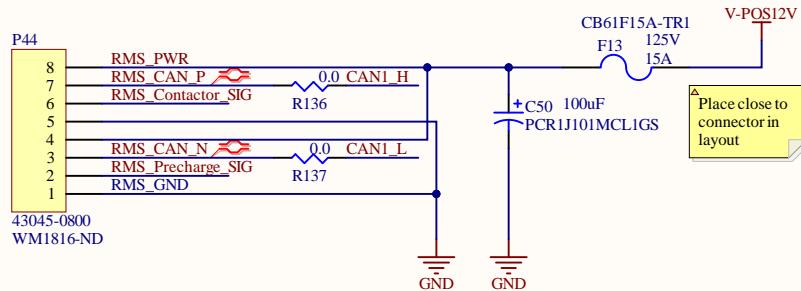
Title BMS Interface		Badgerloop Electrical
Engineer: Shelby Riggelman	Revision: A	133 Engineering Research Building
Date: 3/8/2021	Time: 6:56:49 PM	1500 Engineering Drive
File: bms_interface.SchDoc		Madison, WI 53706



A

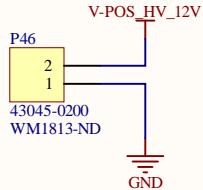
A

Motor Controller Interface



B

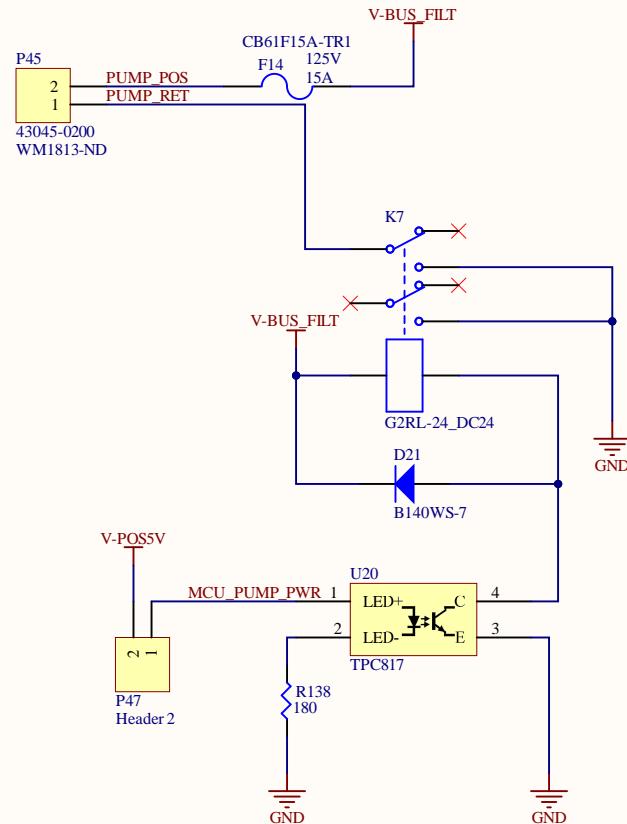
B



C

C

Pump Power



D

D

Title **RMS & Precharge Interface**

Engineer: Shelby Riggelman

Date: 3/8/2021

File: motor_controller_interface.SchDoc

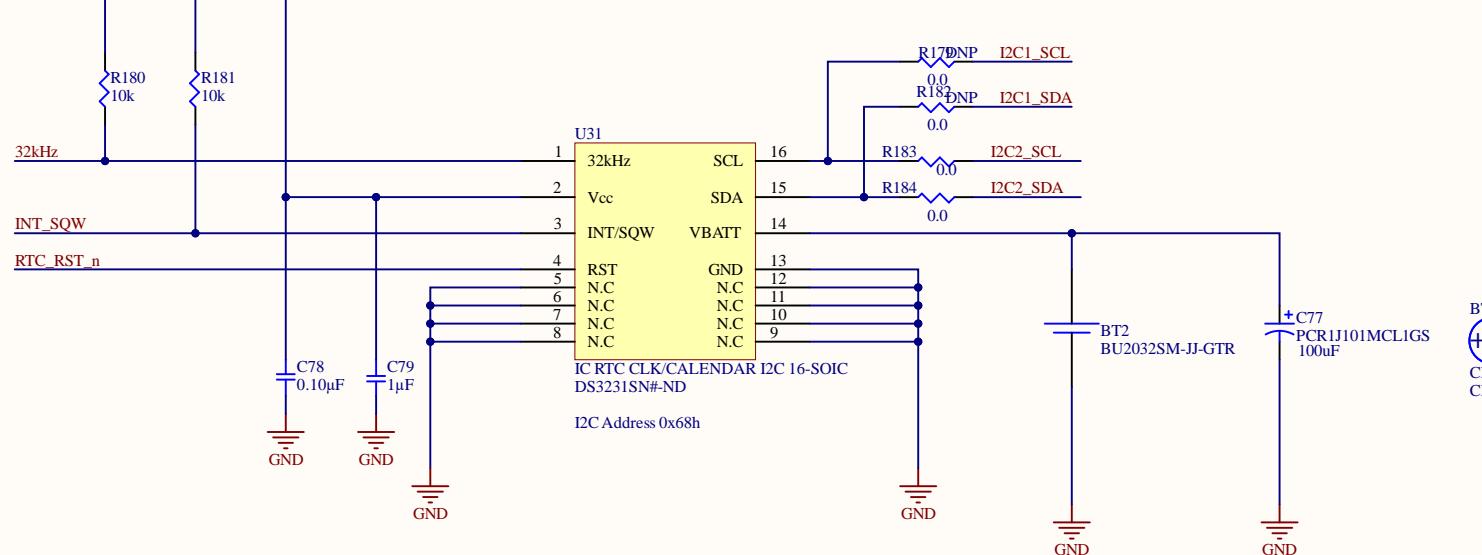
Badgerloop Electrical
133 Engineering Research Building
1500 Engineering Drive
Madison, Wi 53706

BADGER
LOOP

Real Time Clock & Coin Cell

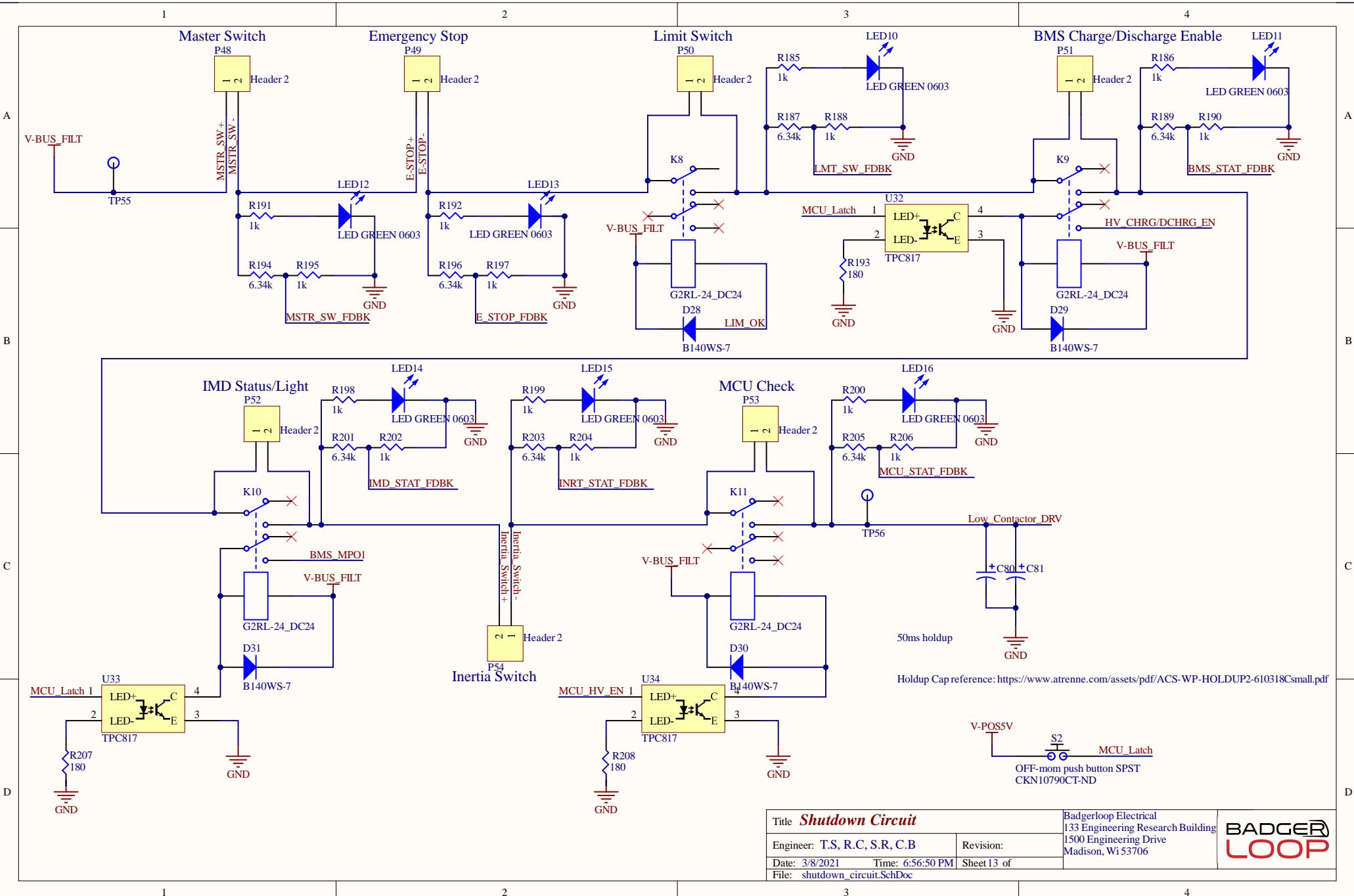
Function determined by
 INTCN bit in OEh - SQW
 if 0, Active low interrupt if
 1 and alarm enabled

 Default = interrupt, but
 alarm is disabled

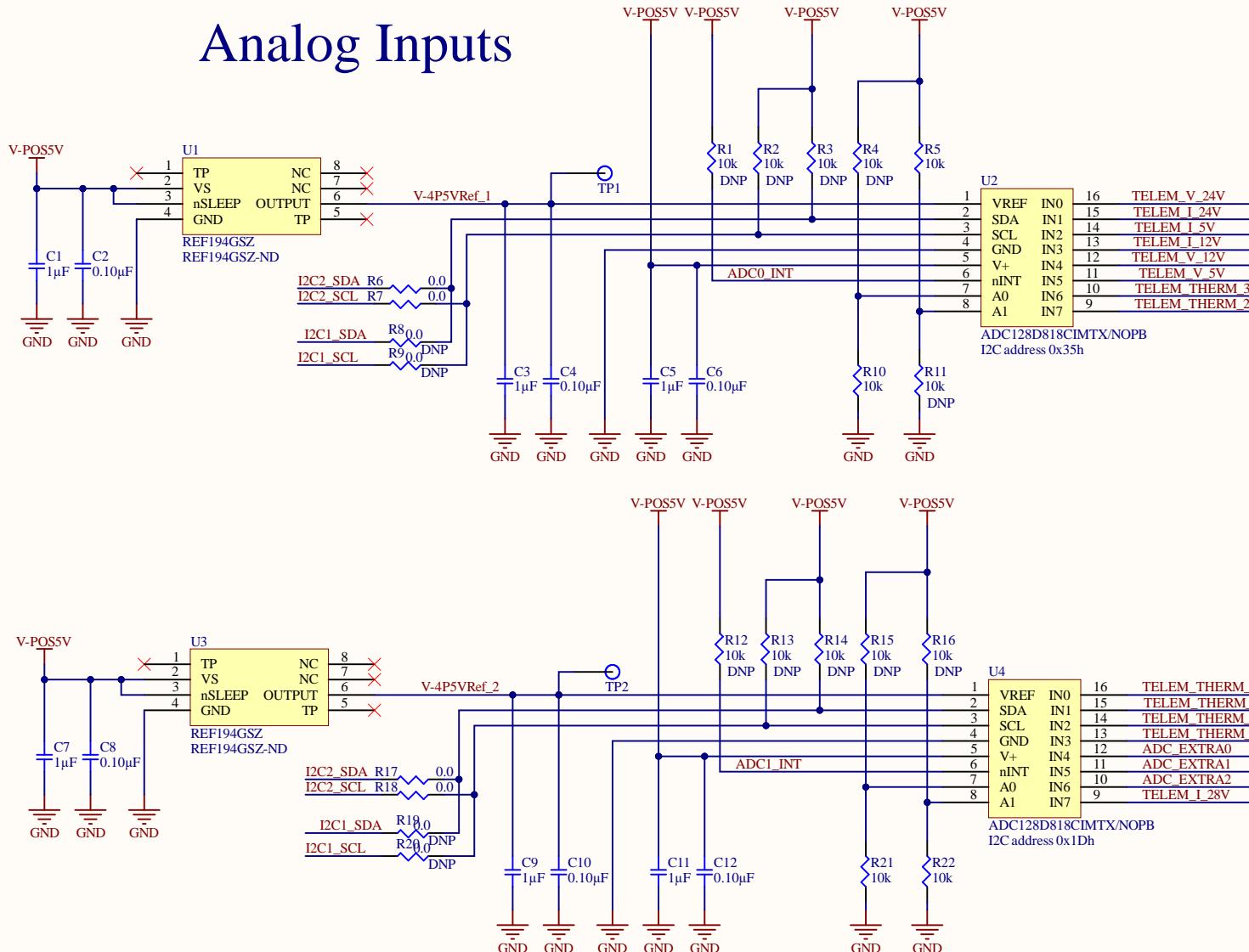


BT1
 CR2032VP
 CR2032VP

Title RTC			<i>Badgerloop</i> 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:	Revision:	
Date: 3/8/2021	Time: 6:56:50 PM	Sheet 12 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\RTC.SchDoc			BADGER LOOP

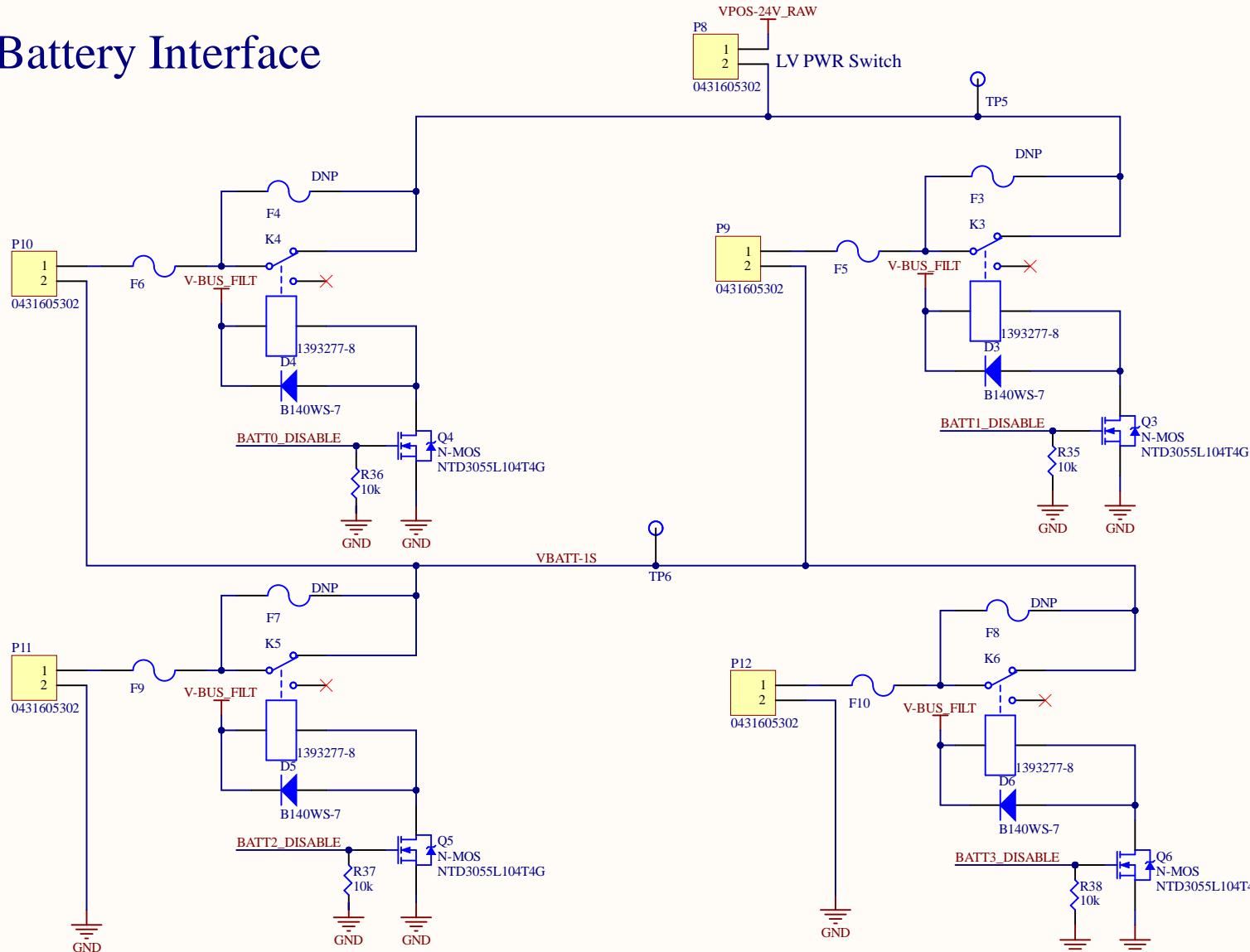


Analog Inputs



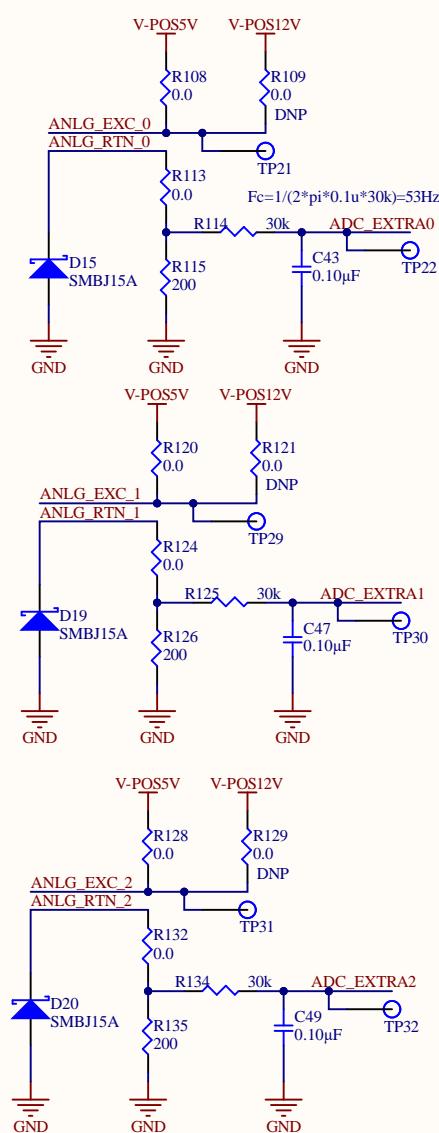
Title: ADC	<i>Badgerloop</i> 133 Engineering Research Building Madison, WI 53715
Size: A4	Number: _____
Date: 3/8/2021	Revision: _____
Time: 6:56:51 PM	Sheet 14 of _____
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\adc.SchDoc	

LV Battery Interface

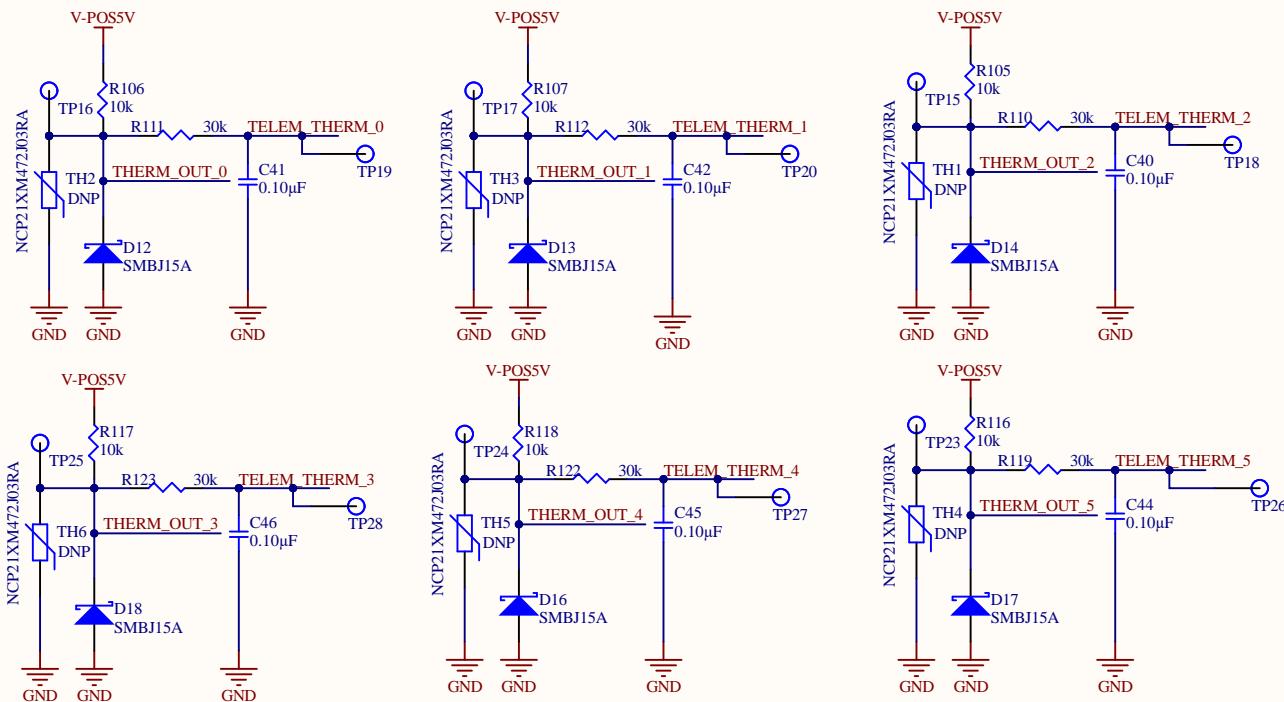


Title LV Battery Interface			<i>Badgerloop 133 Engineering Research Building Madison, WI 53715</i>
Size: A4	Number:	Revision:	
Date: 3/8/2021	Time: 6:56:51 PM	Sheet 15 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\battery_interface.SchDoc			BADGER LOOP

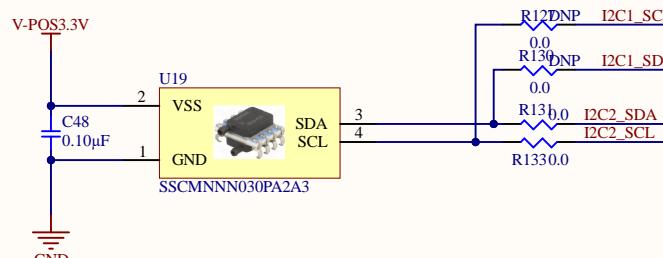
Extra Analog Sensors



Thermistors

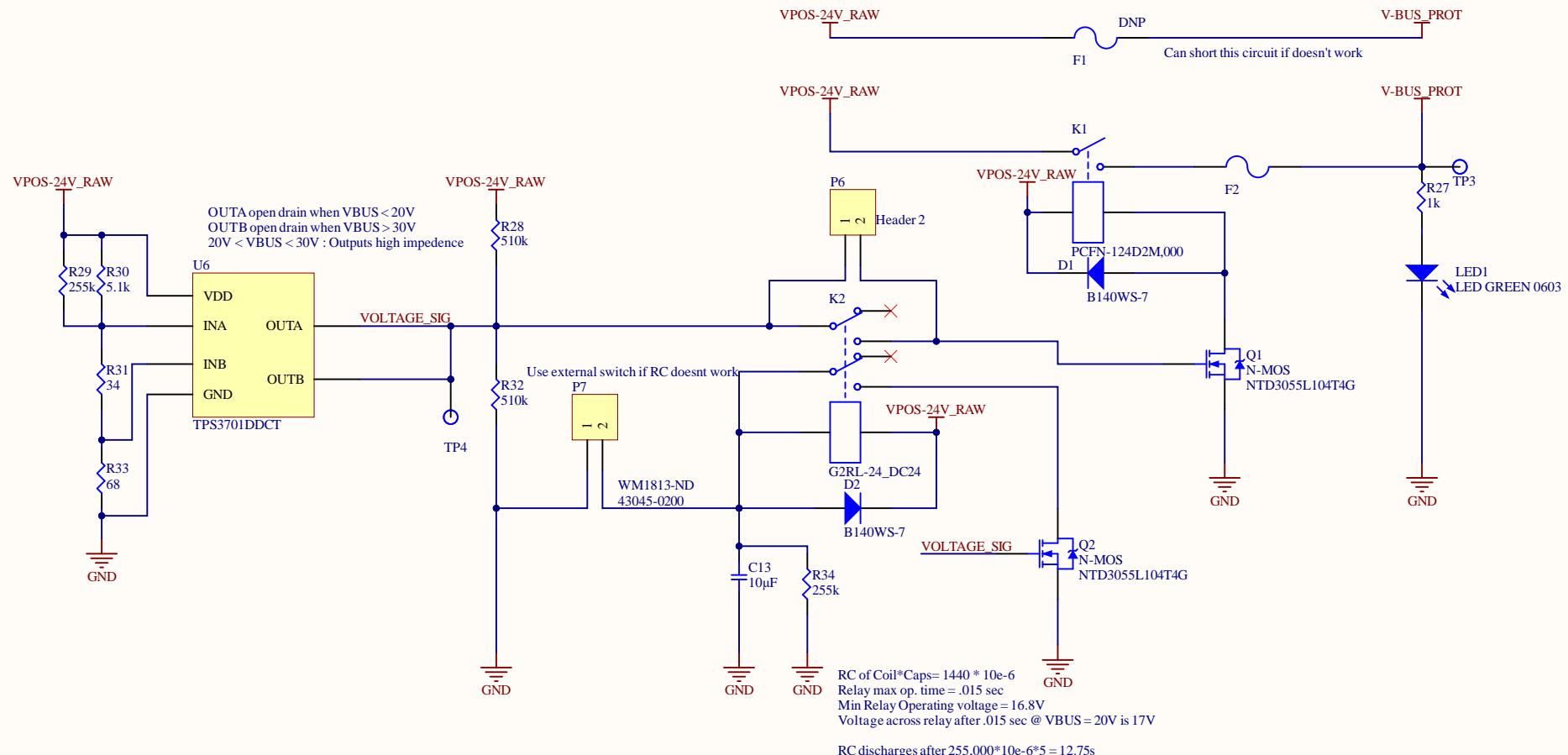


Ambient Pressure Sensor

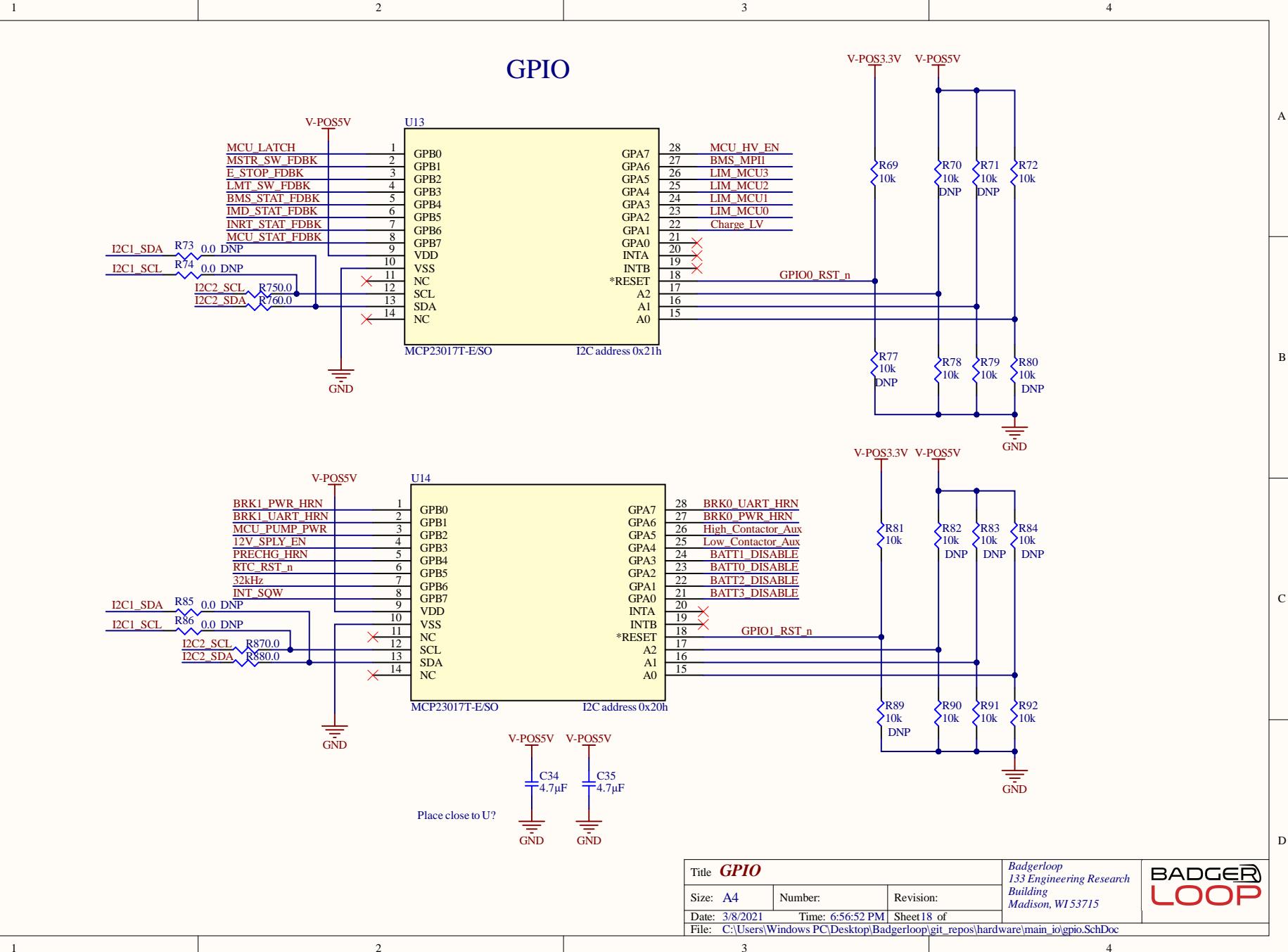


Title: Sensors			Badgerloop 133 Engineering Research Building Madison, WI 53715	BADGER LOOP
Size: A4	Number:	Revision:		
Date: 3/8/2021	Time: 6:56:51 PM	Sheet 16 of		
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\misc_sensors.SchDoc				

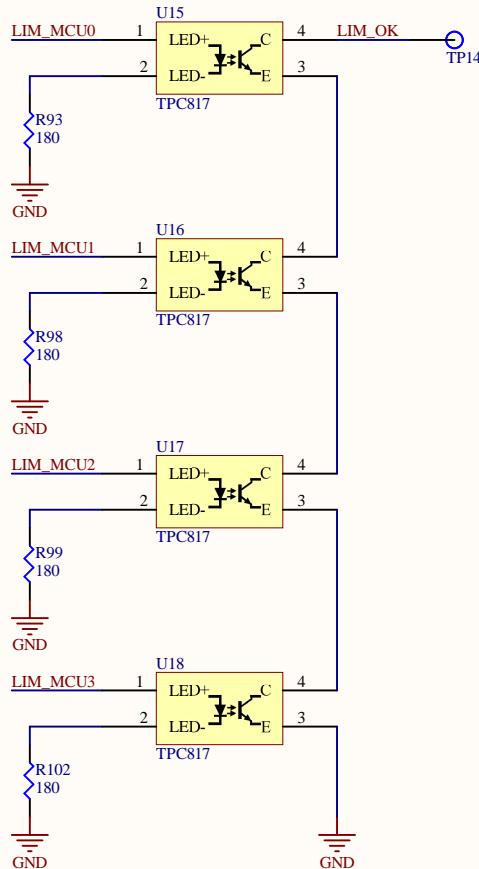
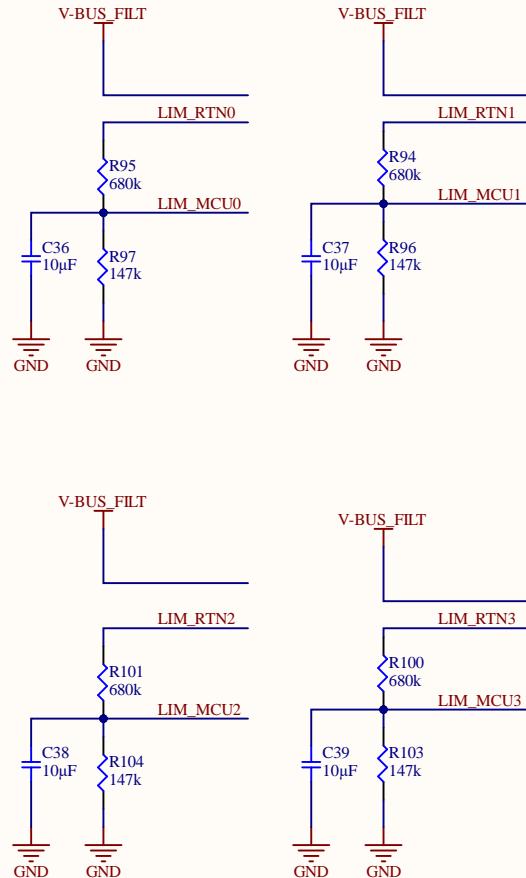
BATTERY PROTECTION



Title: Battery Protection	Badgerloop 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:
Date: 3/8/2021	Revision:
Time: 6:56:51 PM	Sheet 17 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\batt_protection.SchDoc	

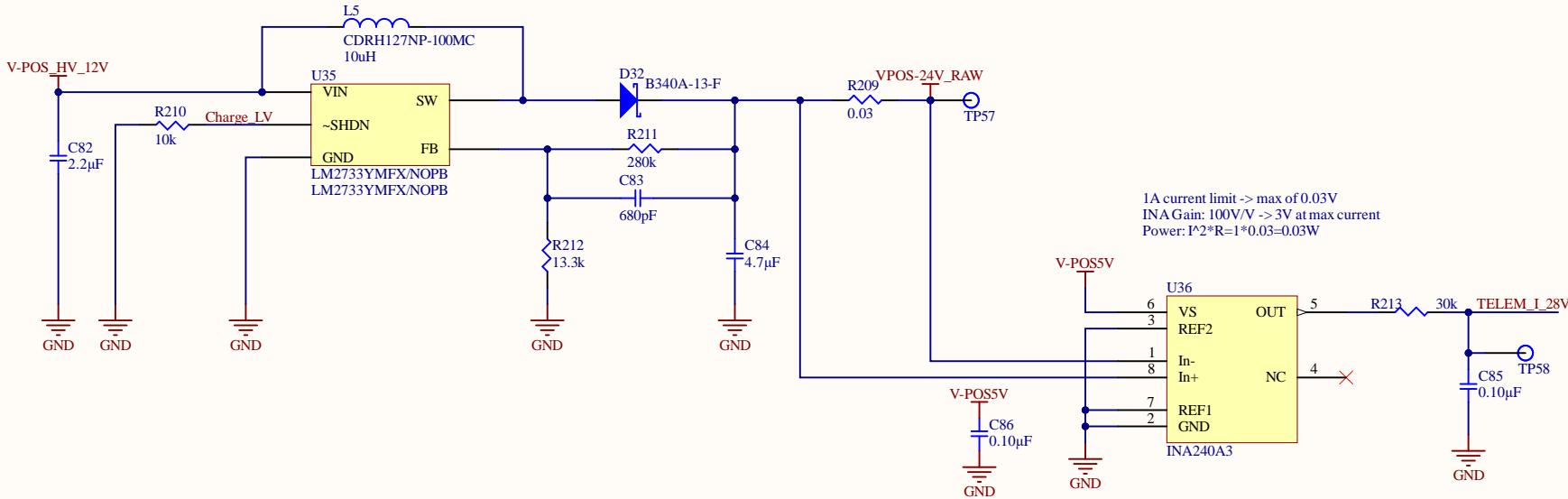


Limit Switch Feedback



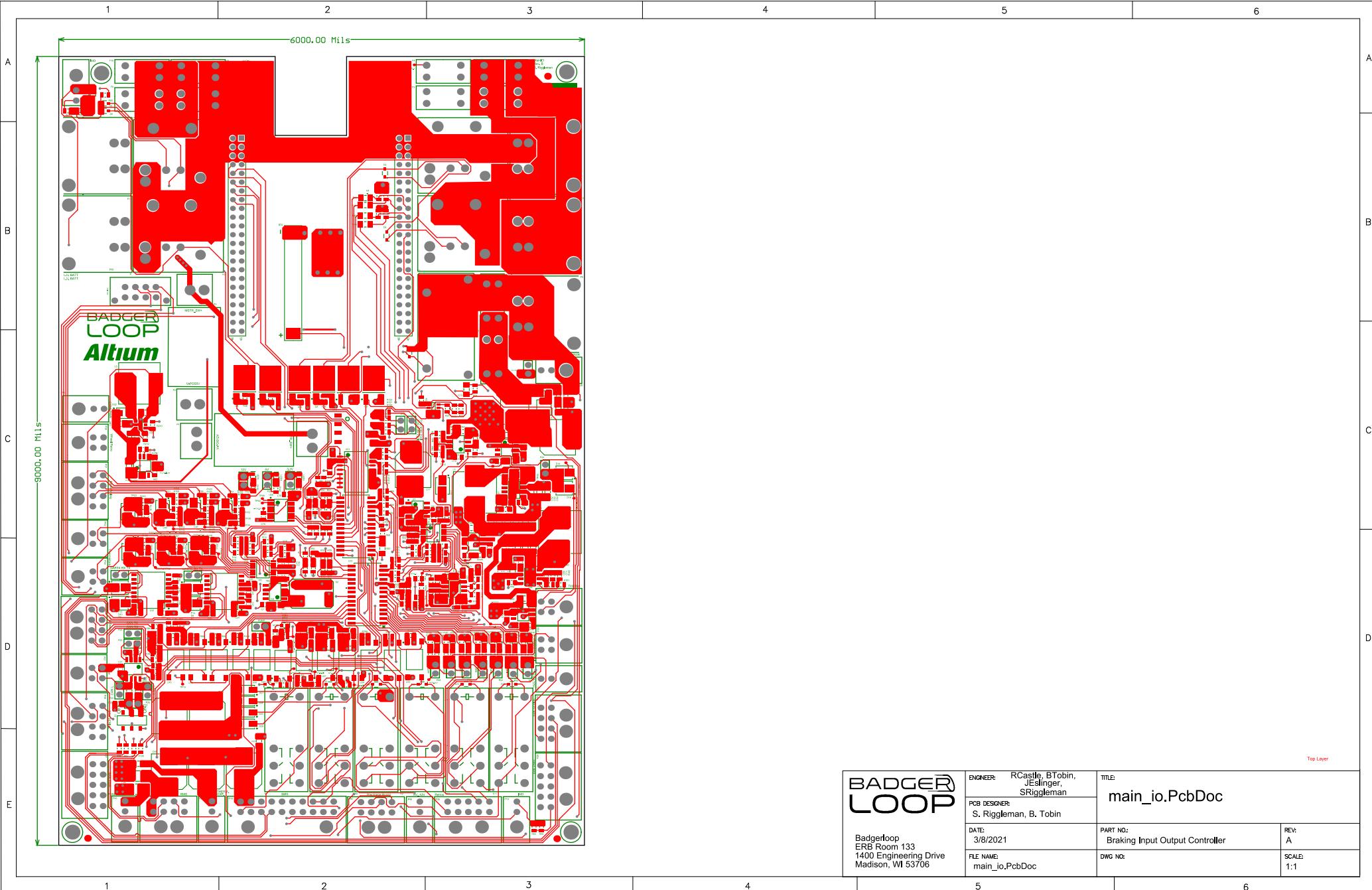
Title: Limit Switches	Badgerloop 133 Engineering Research Building Madison, WI 53715	BADGER LOOP
Size: A4	Number:	Revision:
Date: 3/8/2021	Time: 6:56:52 PM	Sheet 19 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\limit_switches.SchDoc		

HV Batt 12V -> 28V

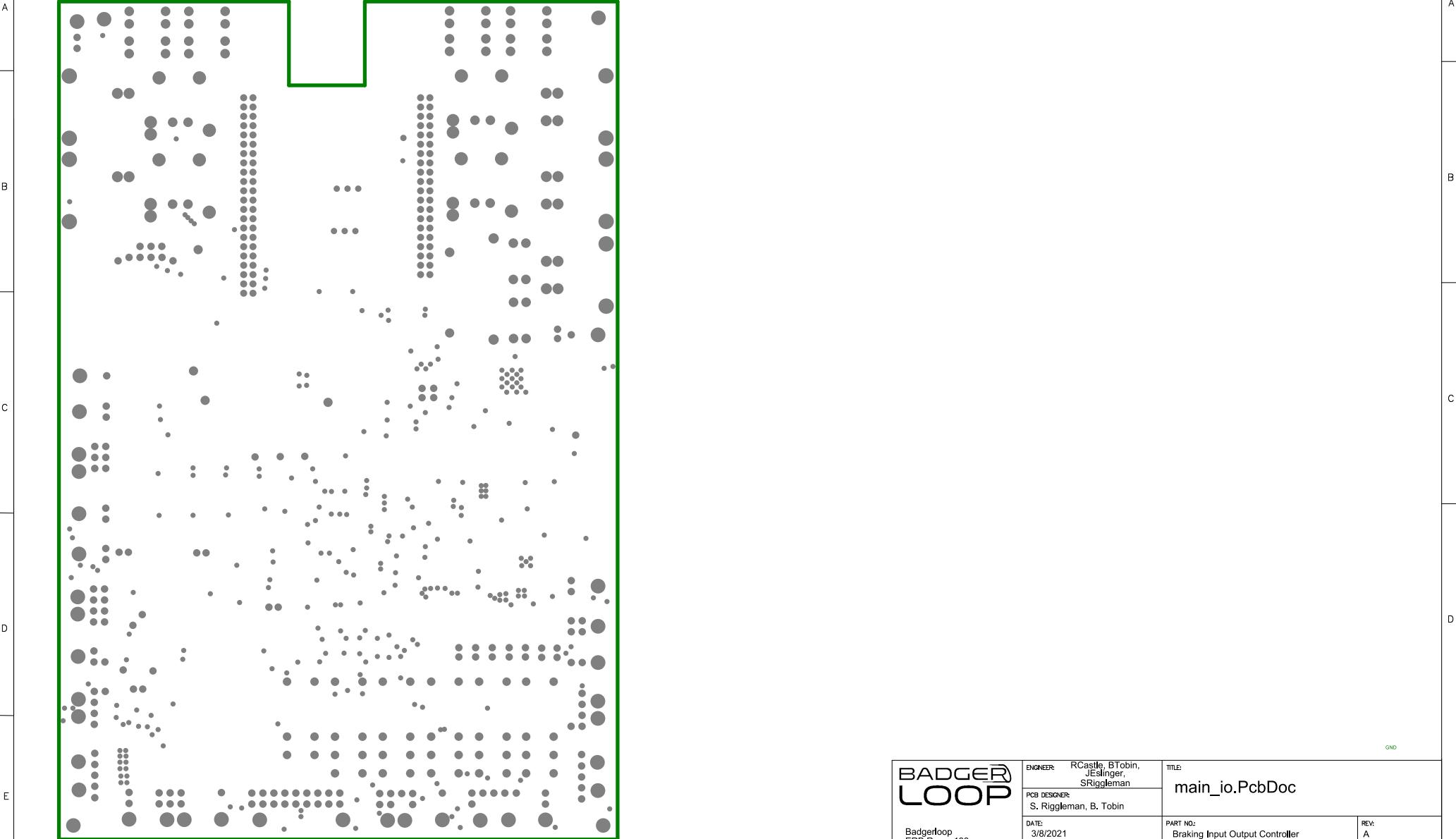


CURRENT TELEM

Title: 28V Boost	Badgerloop
Size: A4	Number:
Date: 3/8/2021	Revision:
Time: 6:56:52 PM	Sheet 20 of
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\power_28V.SchDoc	



1 2 3 4 5 6



BADGER
LOOP

Badgerloop
ERB Room 133
1400 Engineering Drive
Madison, WI 53706

ENGINEER:
RCastle, BTobin,
JFessinger,
SRiggleman

PCB DESIGNER:
S. Riggleman, B. Tobin

DATE:
3/8/2021

FILE NAME:
main_io.PcbDoc

NAME:
main_io.PcbDoc

PART NO:
Braking Input Output Controller

DWG NO:
A

GND

6

1

2

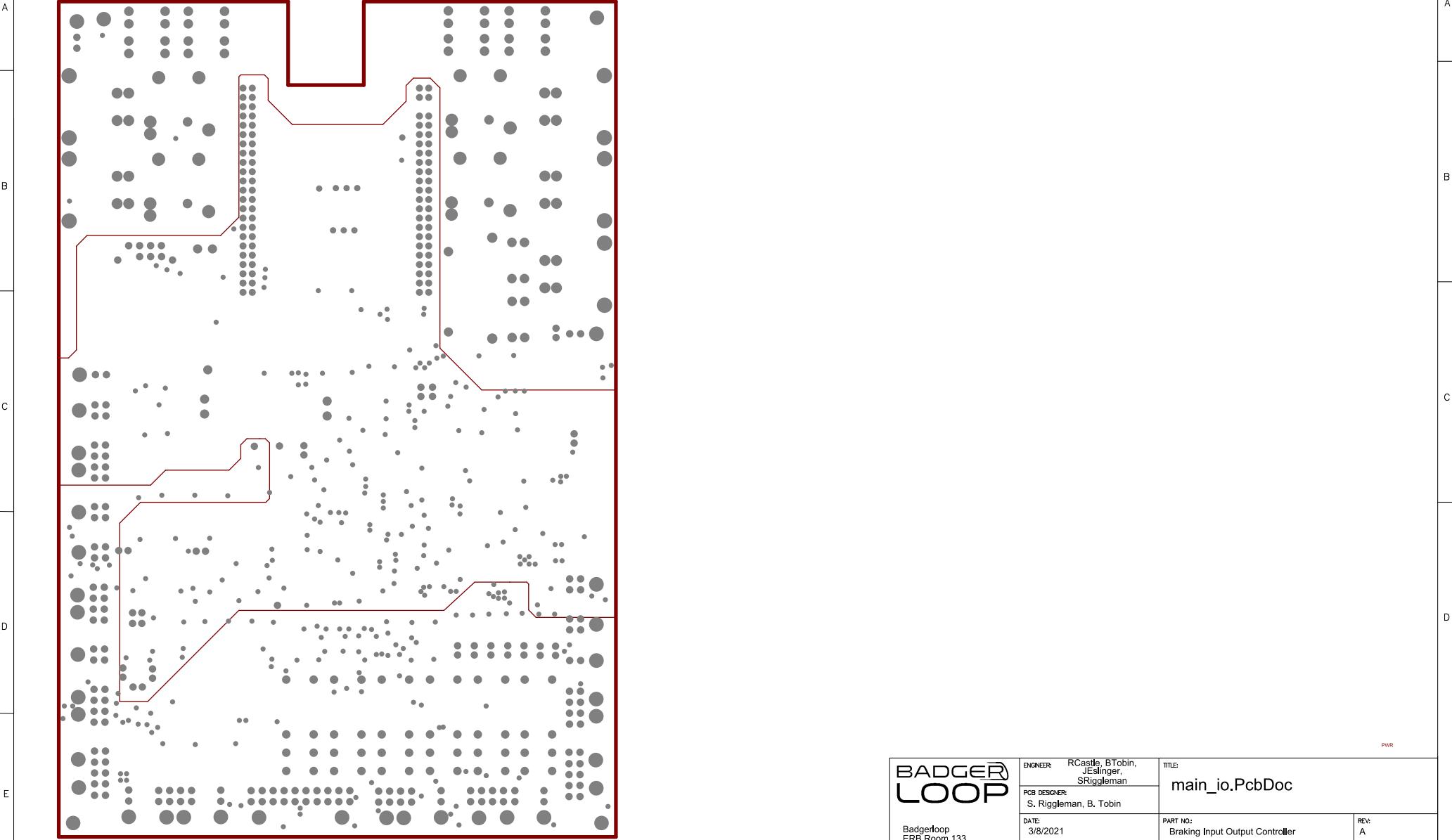
3

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1 2 3 4 5 6



**BADGER
LOOP**

Badgerloop
ERB Room 133
1400 Engineering Drive
Madison, WI 53706

ENGINEER:	R Castle, B Tobin, J Ellinger, S Riggelman	FILE:	main_io.PcbDoc
PCB DESIGNER:	S. Riggelman, B. Tobin	DATE:	Braking Input Output Controller
DATE:	3/8/2021	DWG NO:	A
FILE NAME:	main_io.PcbDoc	SCALE:	1:1

1 2 3 4 5 6

A

A

B

B

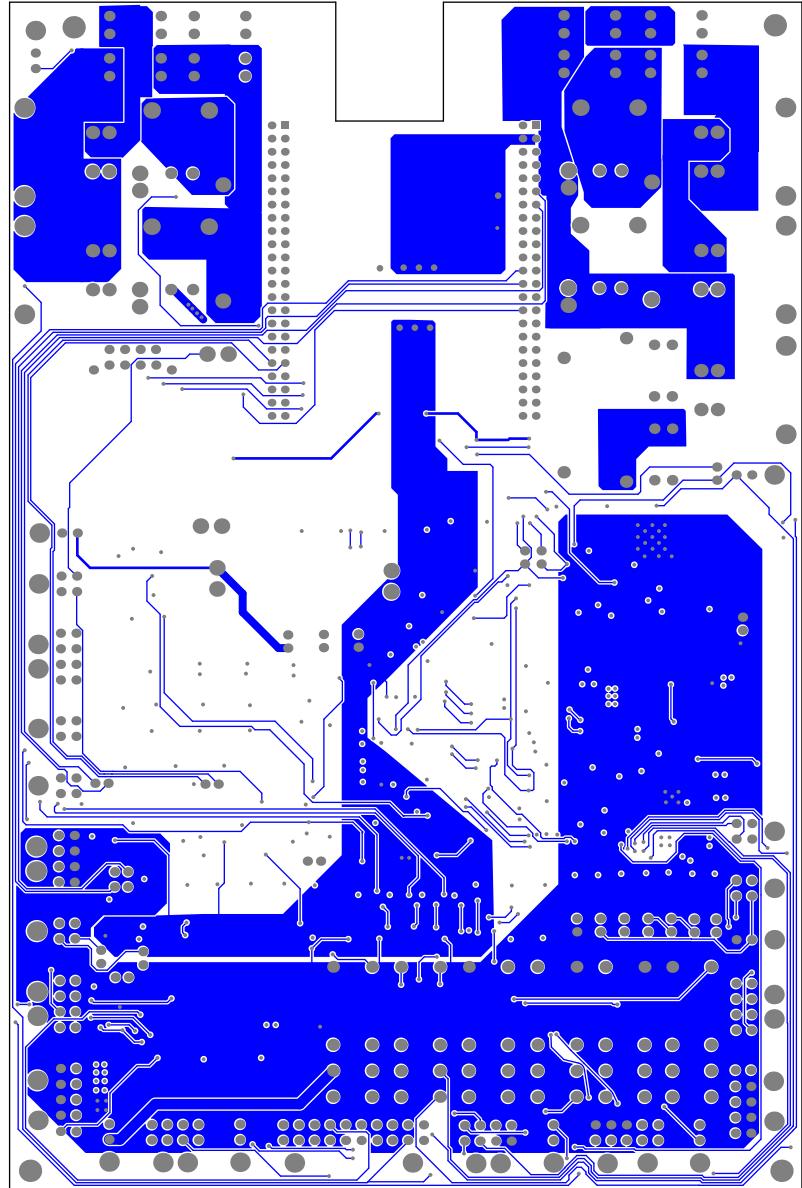
C

C

D

D

E



1 2 3 4 5 6

**BADGER
LOOP**

Badgerloop
ERB Room 133
1400 Engineering Drive
Madison, WI 53706

ENGINEER:	RCastle, BTobin, JFessinger, SRiggleman	FILE:	main_io.PcbDoc
PCB DESIGNER:	S. Riggleman, B. Tobin	DATE:	Braking Input Output Controller
DATE:	3/8/2021	REV:	A
FILE NAME:	main_io.PcbDoc	DWG NO:	SCALE: 1:1

