

A

A

B

B

C

C

D

D

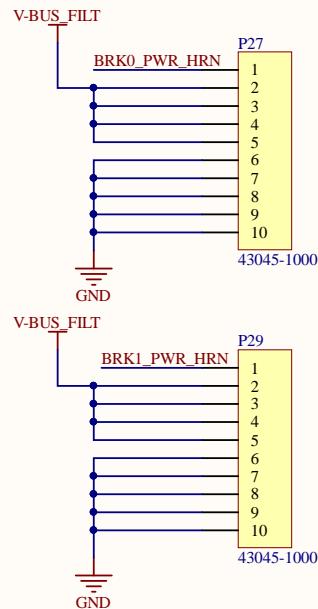
# MAIN IO

## POD 5

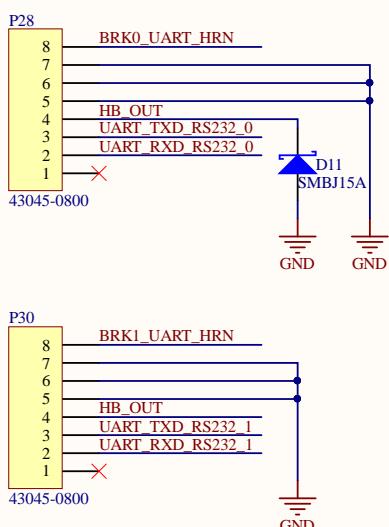
REV 1

Title <b>Main IO</b>		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706	<b>BADGER</b> <b>LOOP</b>
Engineer:	Revision:	Date: 3/6/2021 Time: 11:18:16 PM Sheet 1 of	

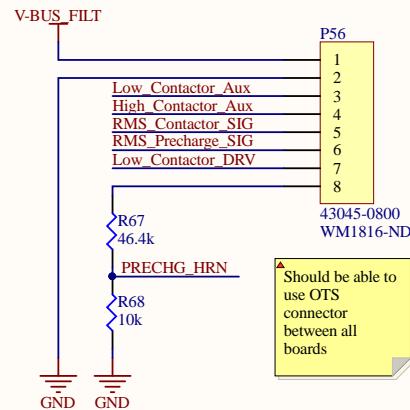
## BrakingIO PWR



## BrakingIO UART



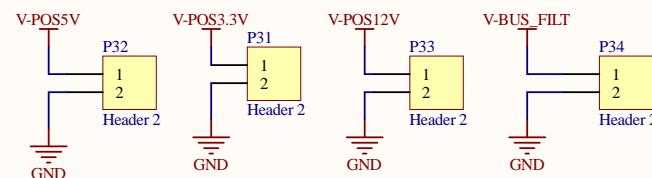
## Precharge Board



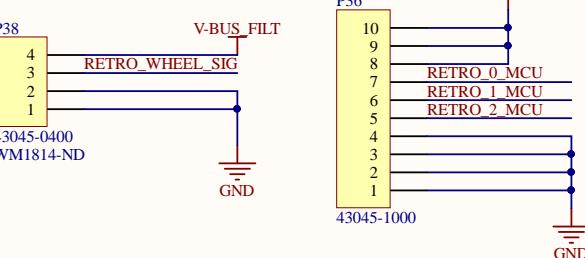
## BMS & RMS

See respective schematics

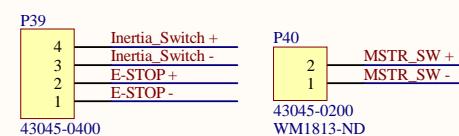
## Debug



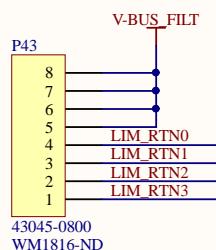
## Retro Sensors



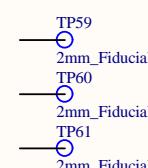
## Shutdown Circuit Inputs



## Limit Switches

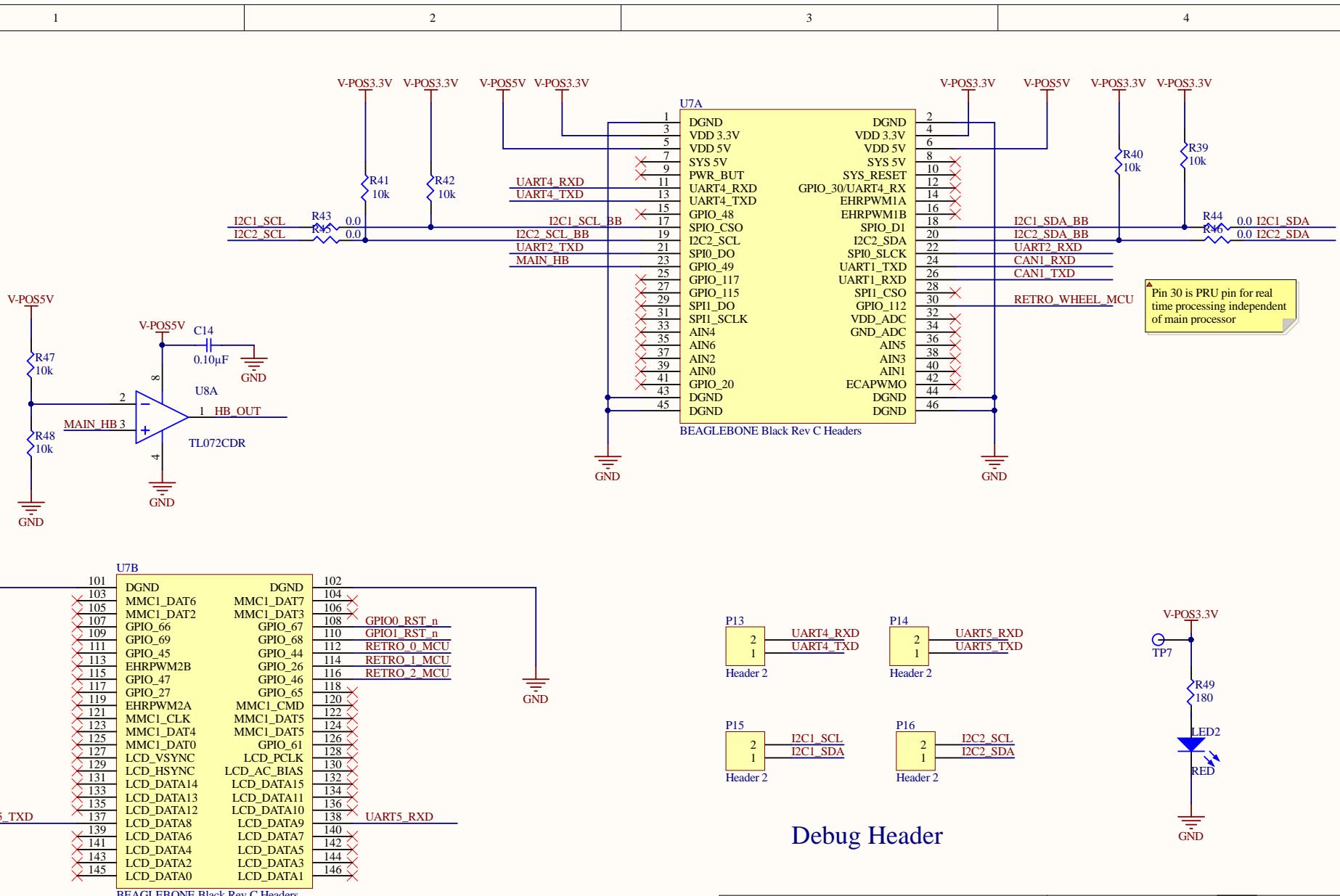


## Fiducials



## Connectors

Engineer:	Revision:	Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Date: 3/6/2021	Time: 11:18:16 PM	Sheet 2 of
File: connectors.SchDoc		<b>BADGER</b> <b>LOOP</b>



Beaglebone Headers

Title <b>Beaglebone</b>		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	<b>BADGER</b> <b>LOOP</b>
Date: <b>3/6/2021</b>	Time: <b>11:18:16 PM</b>	Sheet <b>3</b> of <b>1</b>
File: <a href="#">beaglebone.SchDoc</a>		

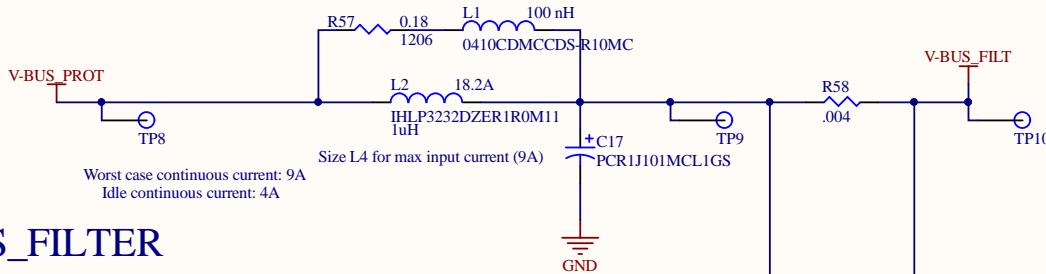
1

2

3

4

A

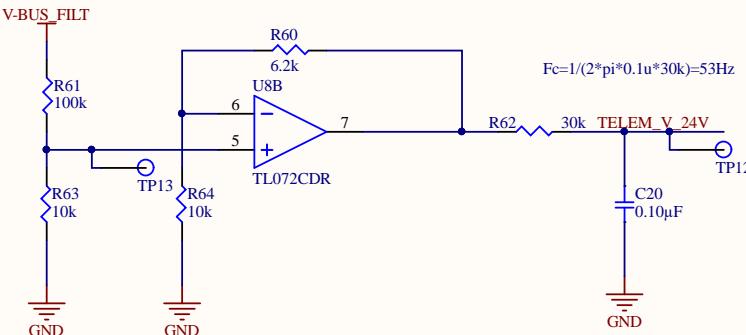


## BUS\_FILTER

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

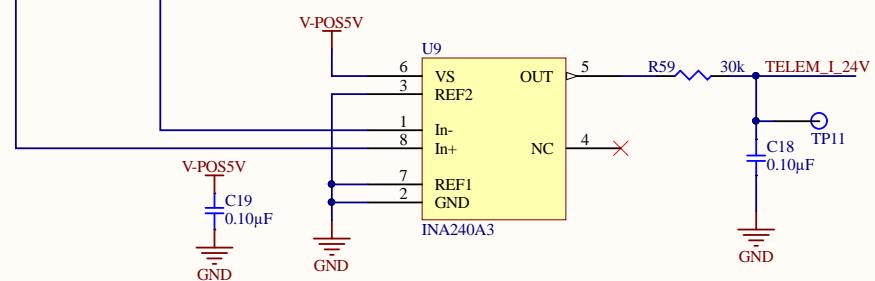
Max current draw: 9A > 9A\*0.004Ω=0.036V  
 INA Gain: 100V/V > 3.6V at Max current  
 Power:  $I^2 \cdot R = 81 \cdot 0.004 = 0.324W$

B



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

## VOLTAGE TELEMETRY



## CURRENT TELEM

# BUS FILTER

C

Title <b>Bus Filter</b>		Badgerloop Electrical
Engineer:	Revision:	133 Engineering Research Building
Date: 3/6/2021	Time: 11:18:16 PM	1500 Engineering Drive
File: bus_filter.SchDoc		Madison, Wi 53706

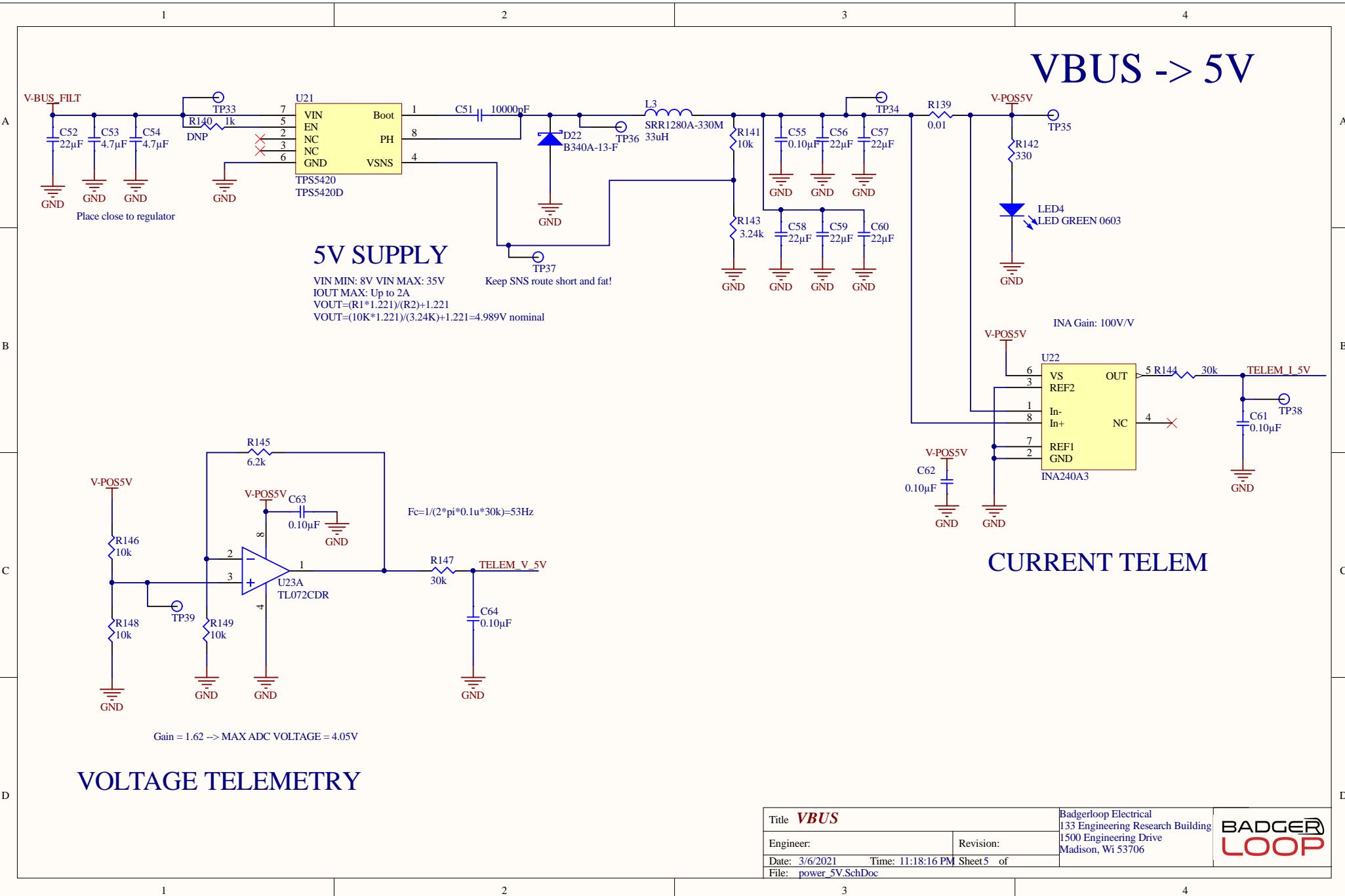


1

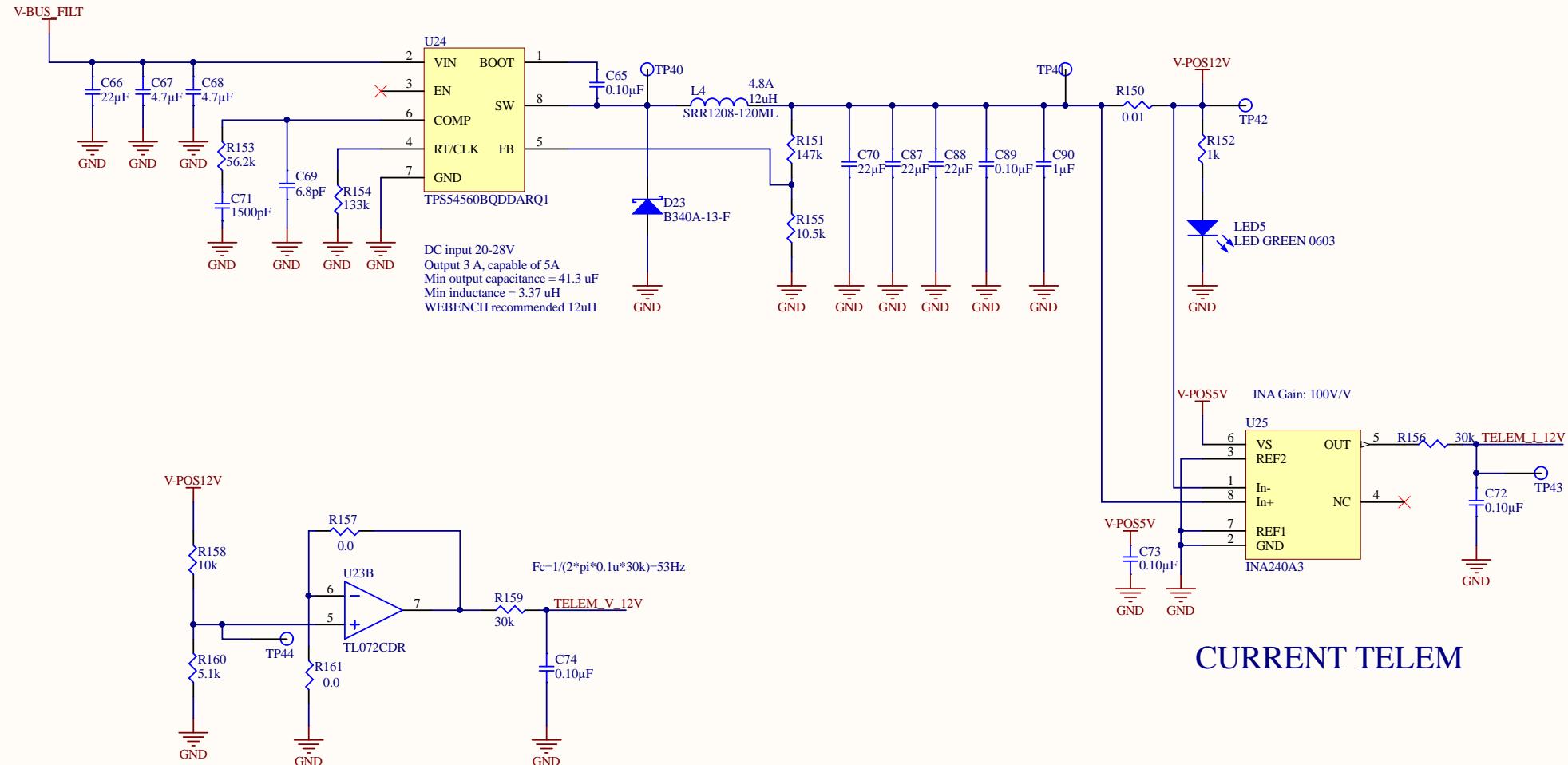
2

3

4



# VBUS -> 12V



## VOLTAGE TELEMETRY

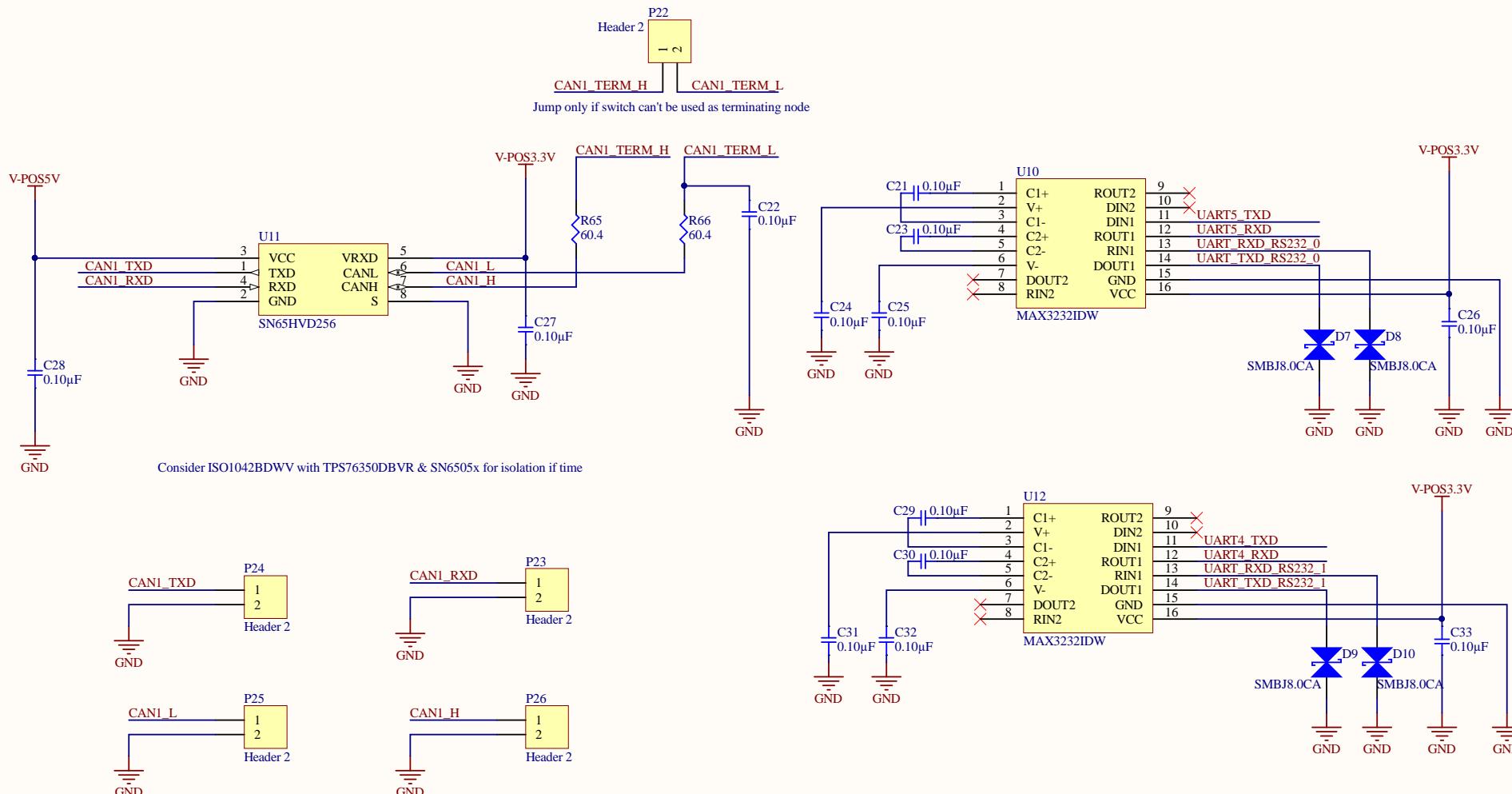
Title <b>12V PWR</b>		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/6/2021	Time: 11:18:16 PM	Sheet 6 of
File: power_12V.SchDoc		<b>BADGER</b> <b>LOOP</b>

1

2

3

4

**CAN****UART (x2)**Title **CAN and UART Interfaces**

Engineer:

Date: 3/6/2021 Time: 11:18:17 PM

File: can\_uart.SchDoc

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

**BADGER**  
**LOOP**

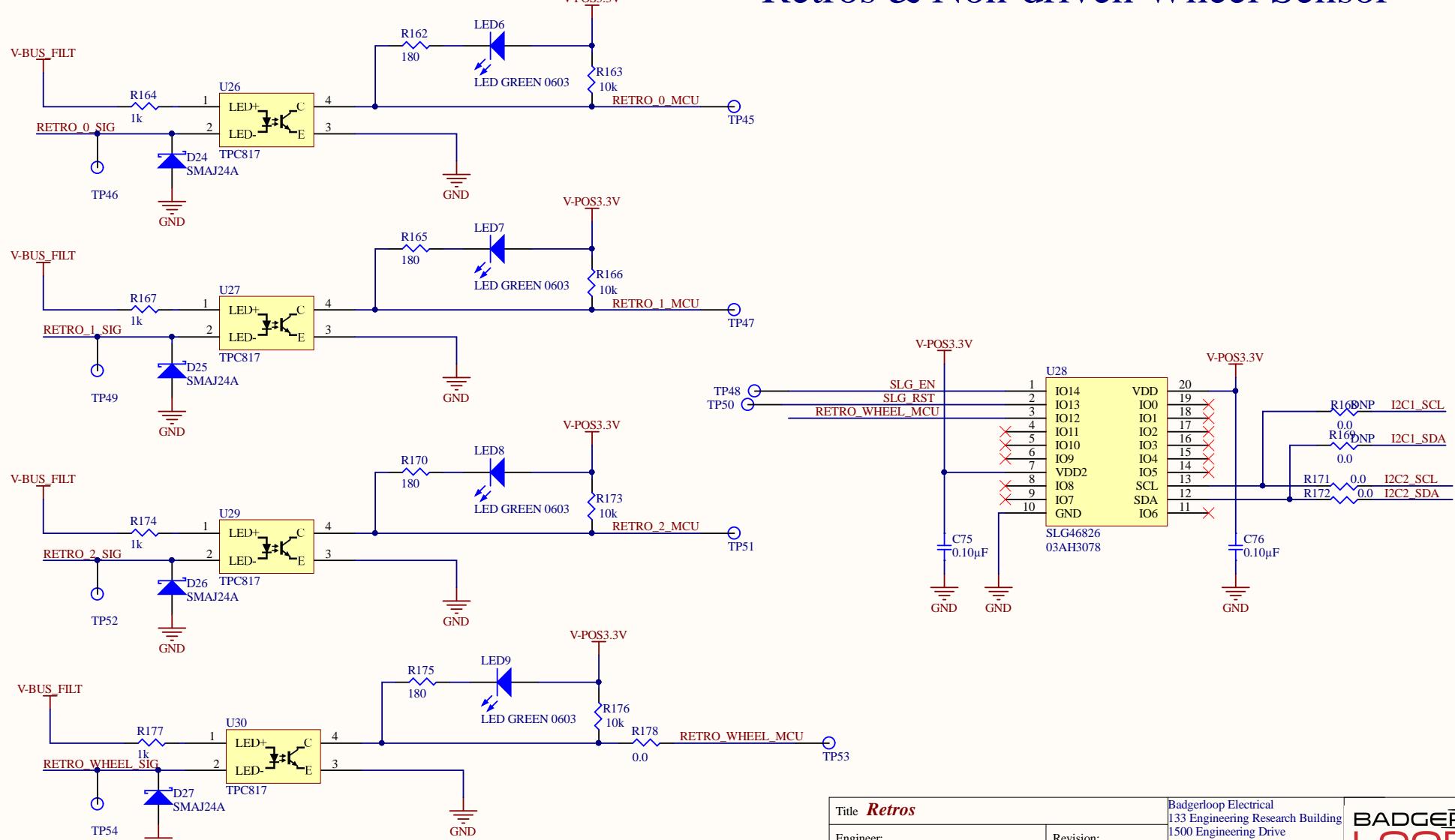
1

2

3

4

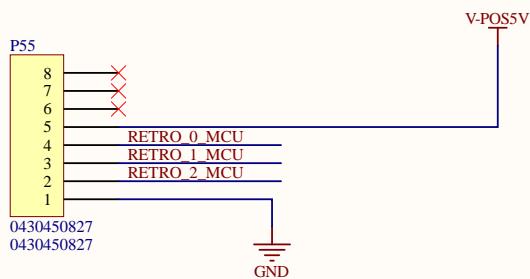
# Retros & Non-driven Wheel Sensor



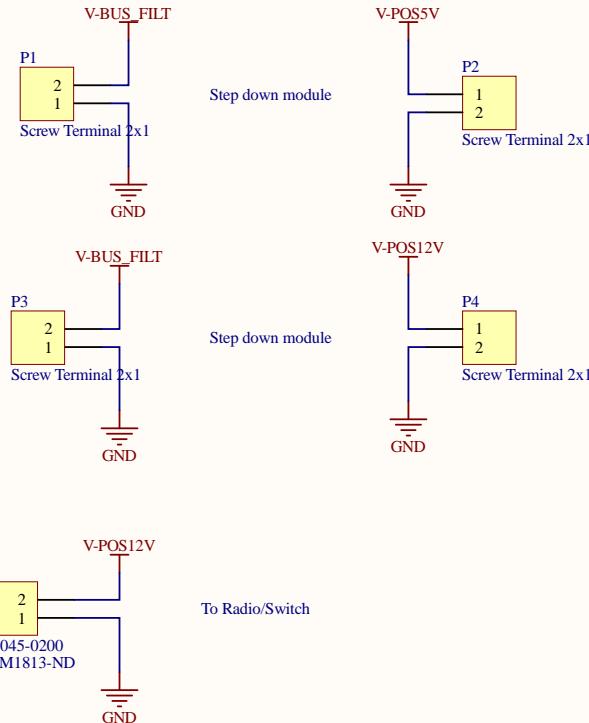
Title <b>Retros</b>		Badgerloop Electrical 133 Engineering Research Building 1500 Engineering Drive Madison, Wi 53706
Engineer:	Revision:	
Date: 3/6/2021	Time: 11:18:17 PM	Sheet 8 of
File: retros.SchDoc		<b>BADGER</b> <b>LOOP</b>

## Arduino Interface

Only if SX still requires this



## OTS Device Connections



Title *Arduino Shield*

Engineer:

Revision:

Date: 3/6/2021 Time: 11:18:17 PM Sheet 9 of

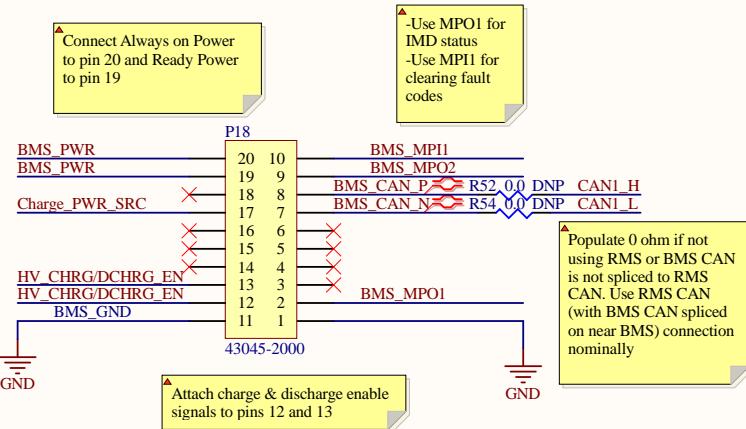
File: *arduino\_shield.SchDoc*

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

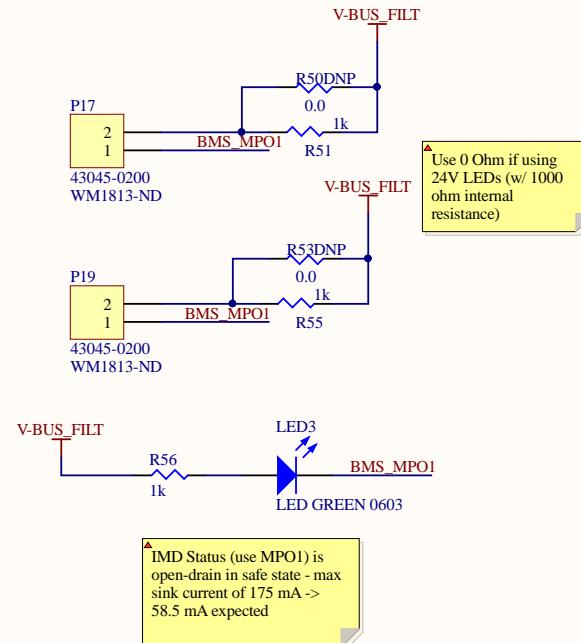


# BMS Interface

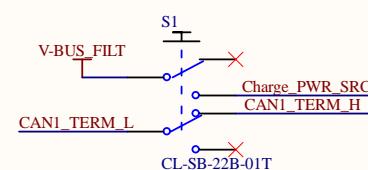
## BMS/Term Main Connectors



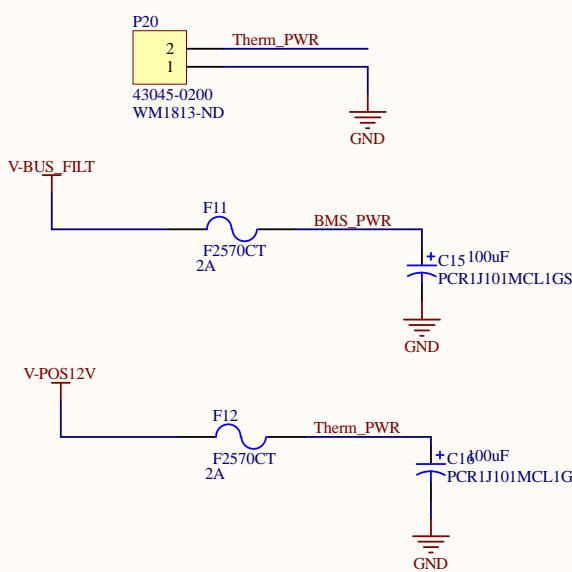
## IMD Light circuit



## Charge Enable & Termination Resistors



- Turn on in defined charging/balancing state  
 - When not in charging state, board is end node and has term. res.  
 - When in charging state, charger is end node and should house term. res.



## Charger Connector



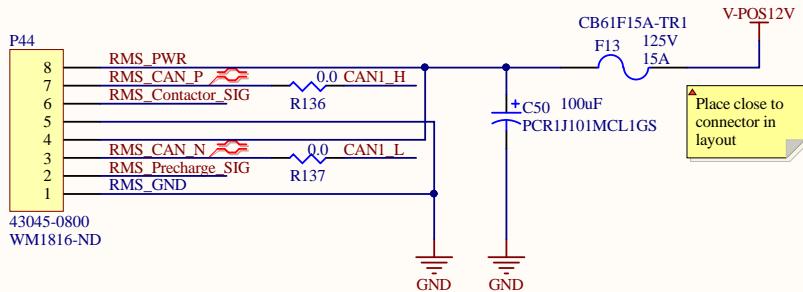
Title <b>BMS Interface</b>		Badgerloop Electrical
Engineer: Shelby Riggelman	Revision:A	133 Engineering Research Building
Date: 3/6/2021	Time: 11:18:17 PM	1500 Engineering Drive
File: bms_interface.SchDoc		Madison, Wi 53706



A

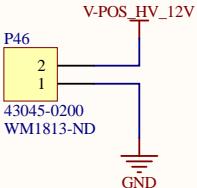
A

## Motor Controller Interface



B

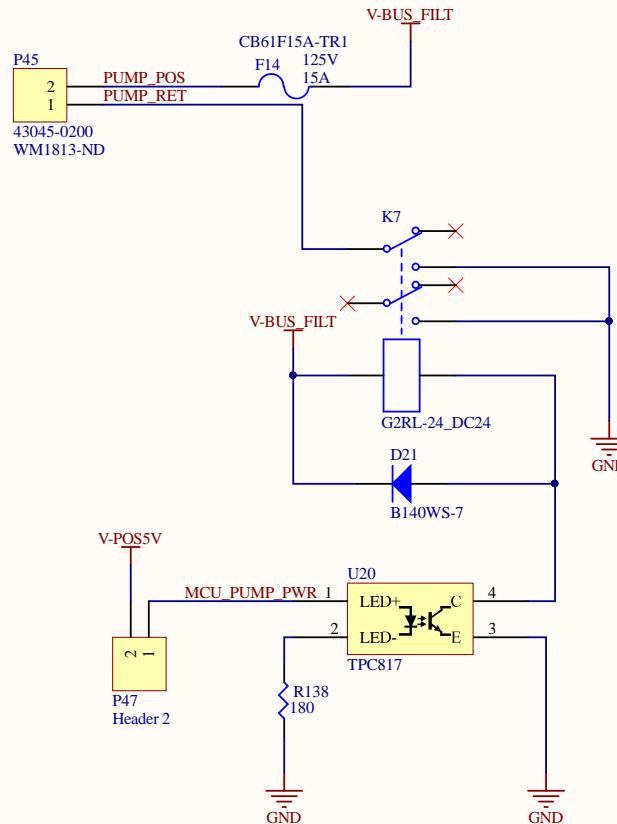
B



C

C

## Pump Power



D

D

Title **RMS & Precharge Interface**

Engineer: Shelby Riggleman

Date: 3/6/2021

File: motor\_controller\_interface.SchDoc

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

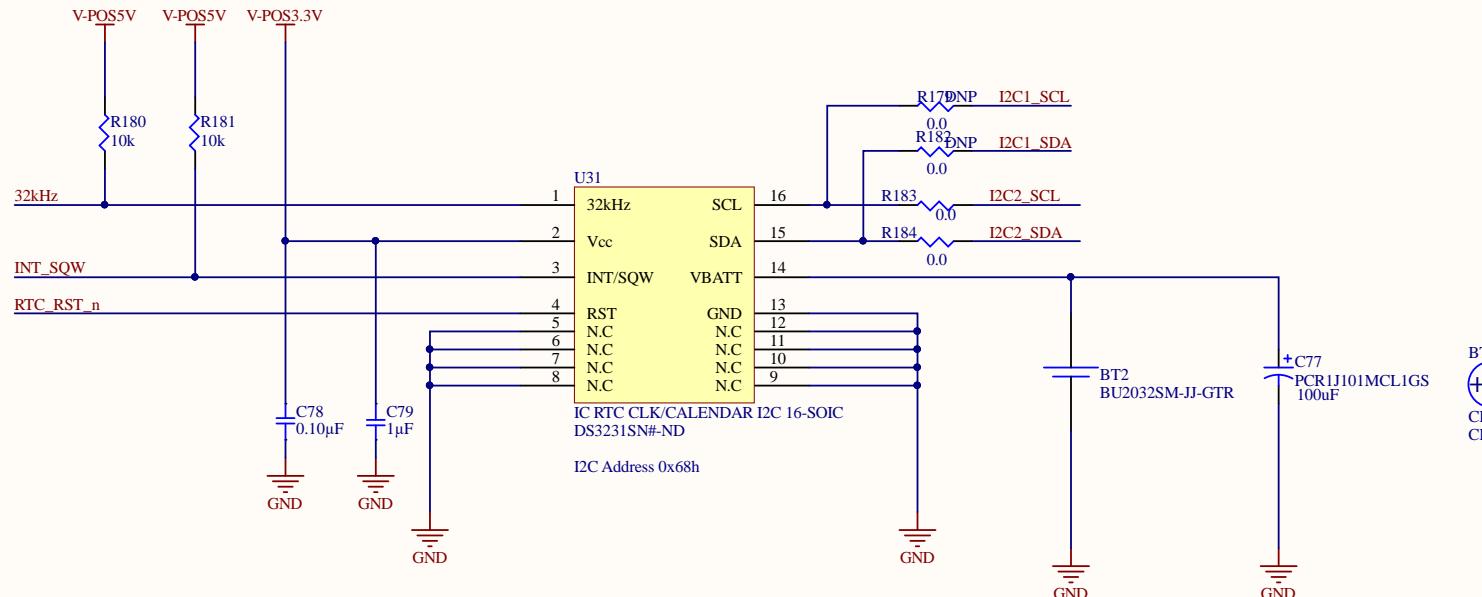


# Real Time Clock & Coin Cell

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

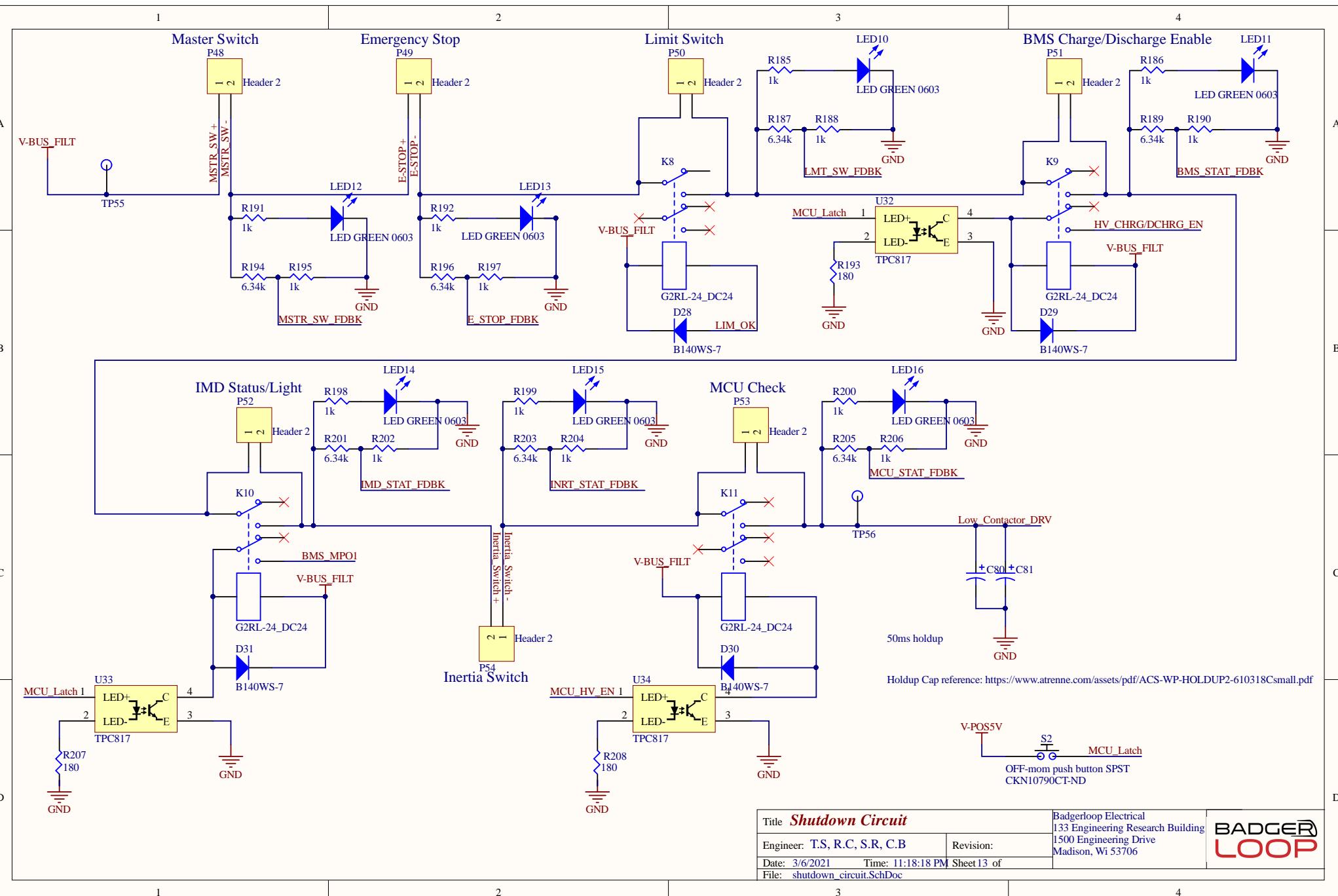
C

C

D

D

Title <b>RTC</b>			<i>Badgerloop</i> 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:	Revision:	<b>BADGER</b> <b>LOOP</b>
Date: 3/6/2021	Time: 11:18:17 PM	Sheet 12 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\RTC.SchDoc			

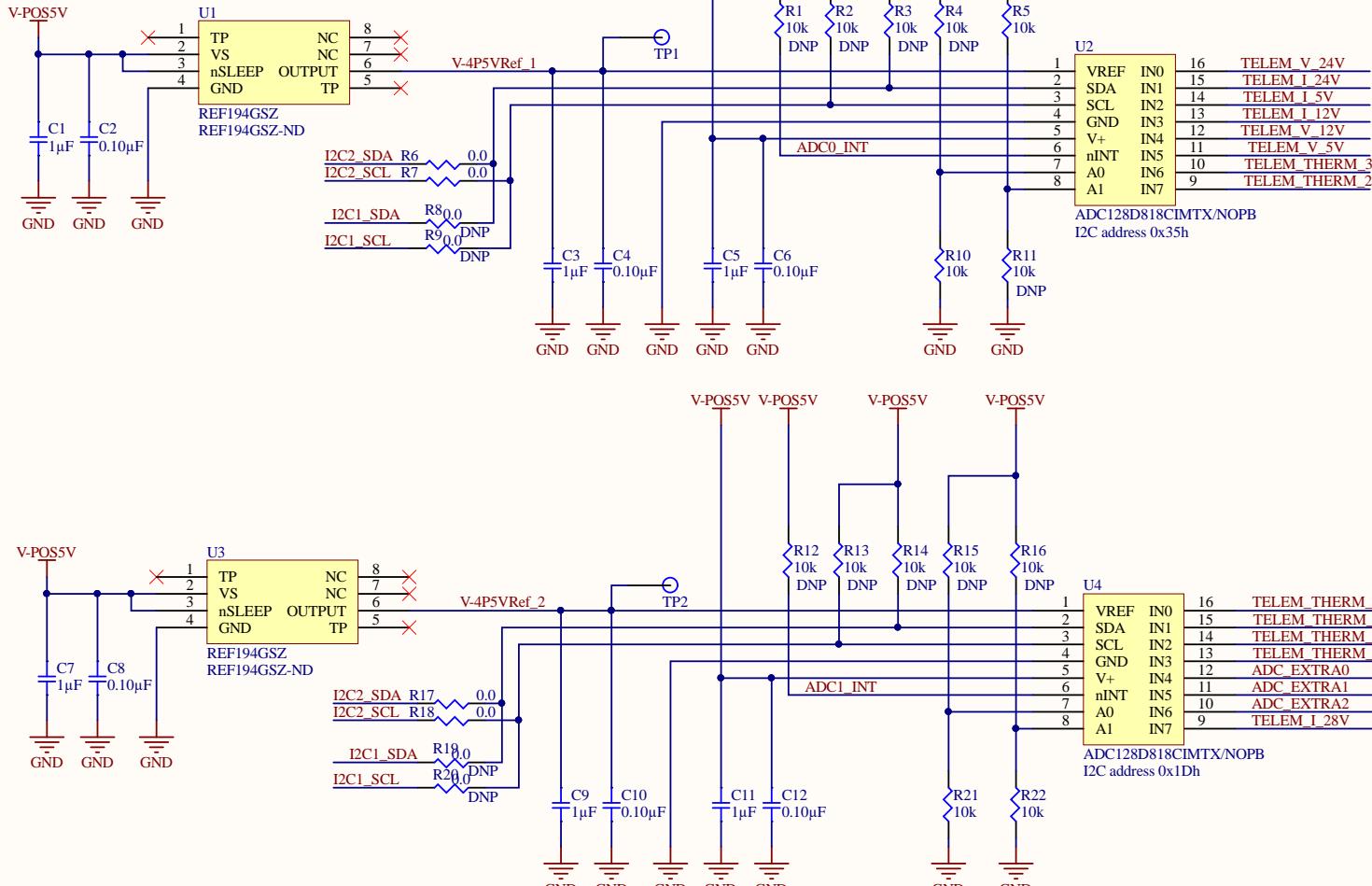


#### Title **Shutdown Circuit**

Engineer: T.S, R.C, S.R, C.B	Revision:
Date: 3/6/2021	Time: 11:18:18 PM Sheet 13 of
File: shutdown_circuit.SchDoc	

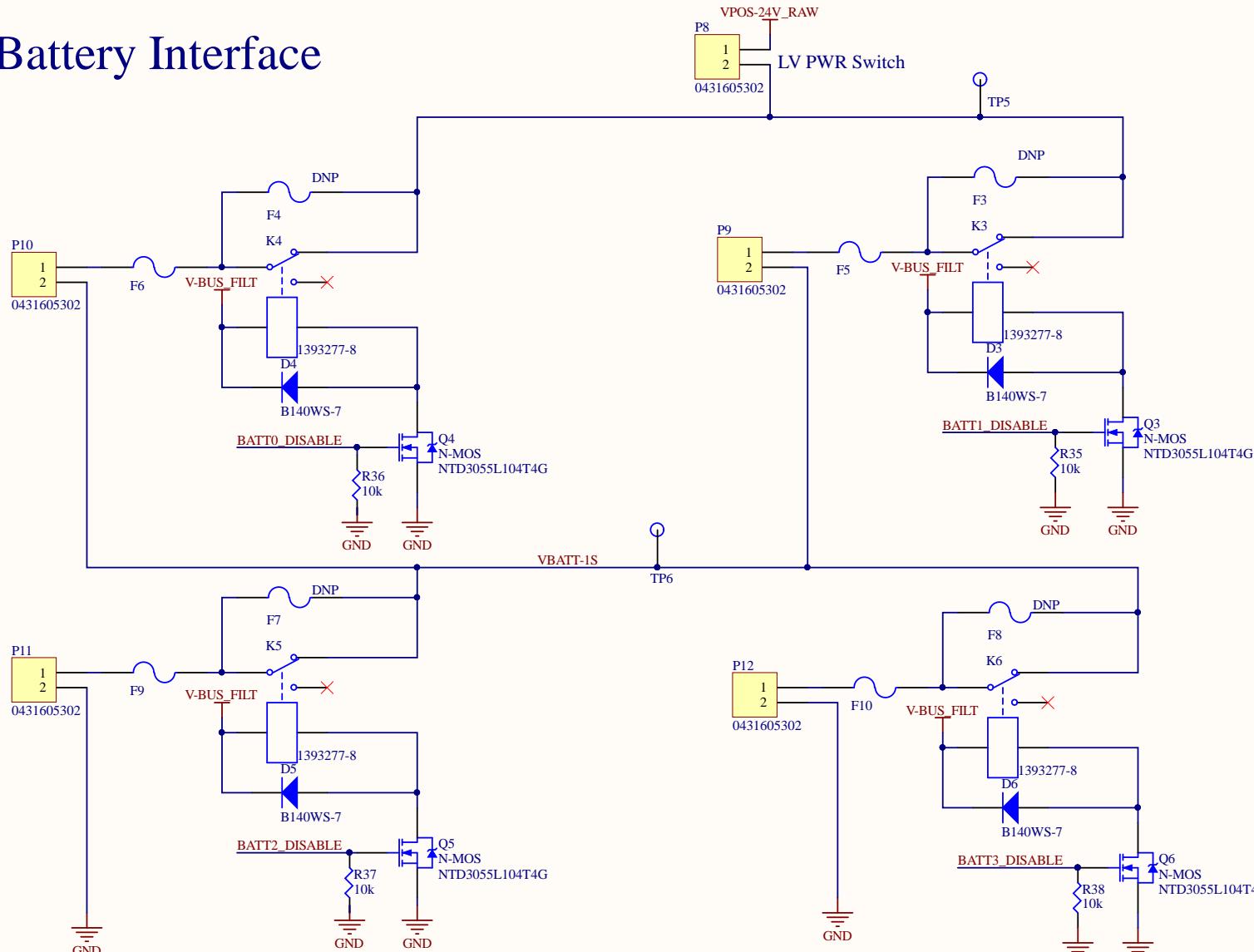
**BADGER LOOP**

# Analog Inputs



Title <b>ADC</b>			<i>Badgerloop 133 Engineering Research Building Madison, WI 53715</i>
Size: A4	Number:	Revision:	
Date: 3/6/2021	Time: 11:18:18 PM	Sheet 14 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\adc.SchDoc			

# LV Battery Interface



Title <b>LV Battery Interface</b>			<i>Badgerloop 133 Engineering Research Building Madison, WI 53715</i>
Size: A4	Number:	Revision:	
Date: 3/6/2021	Time: 11:18:18 PM	Sheet 15 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\battery_interface.SchDoc			<b>BADGER LOOP</b>

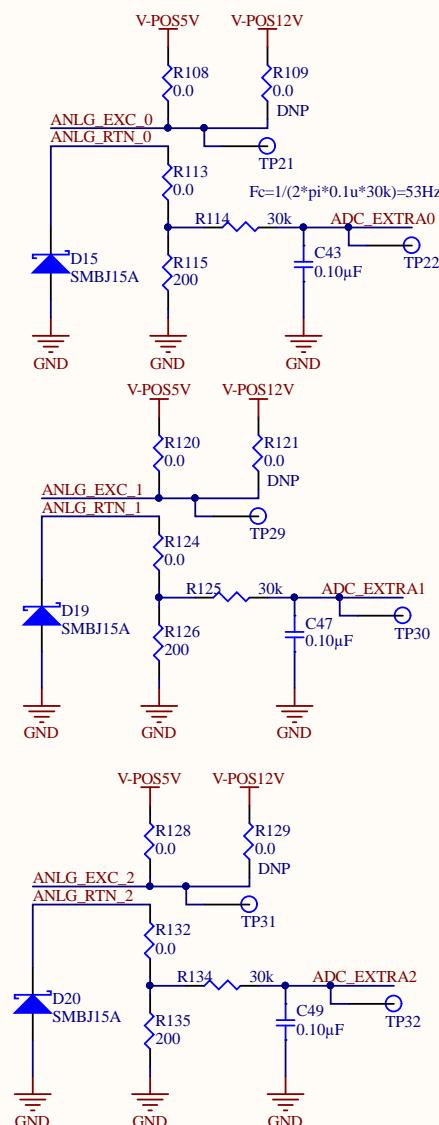
1

2

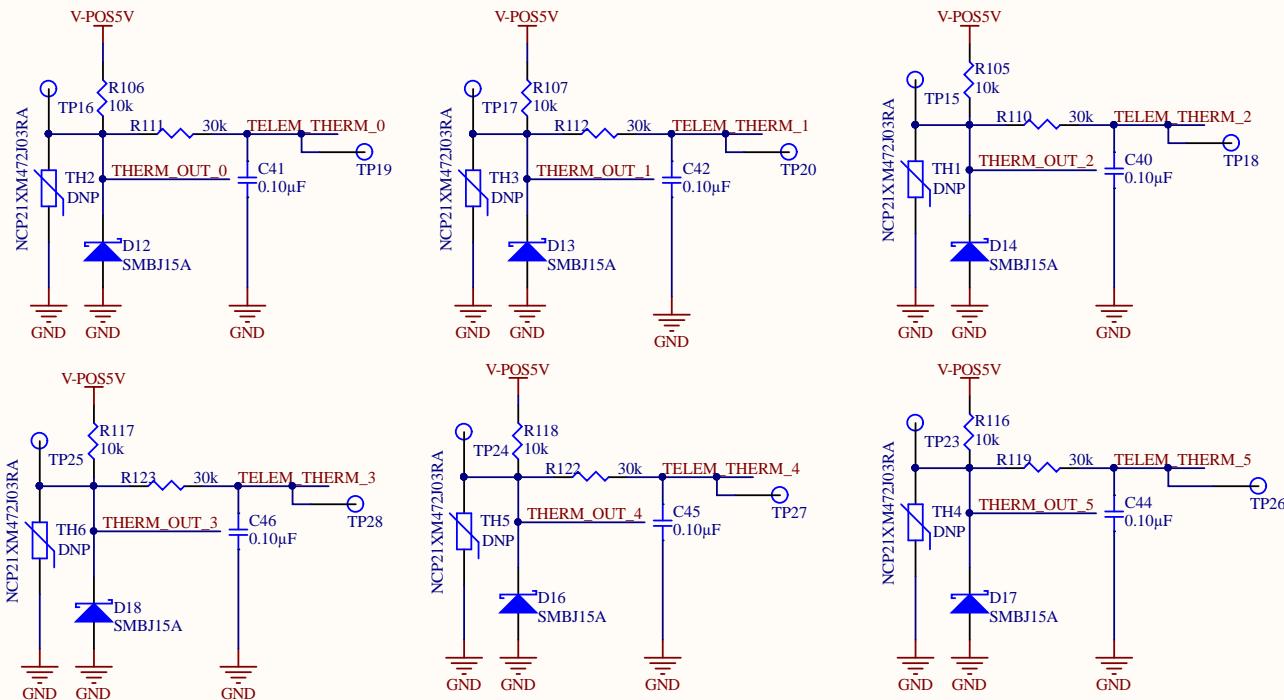
3

4

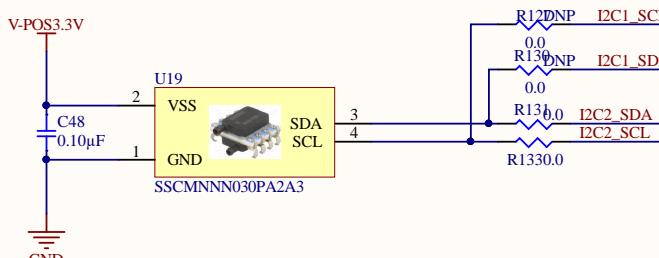
## Extra Analog Sensors



## Thermistors



## Ambient Pressure Sensor



Title: <b>Sensors</b>			Badgerloop 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:	Revision:	
Date: 3/6/2021	Time: 11:18:18 PM	Sheet 16 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\misc_sensors.SchDoc			

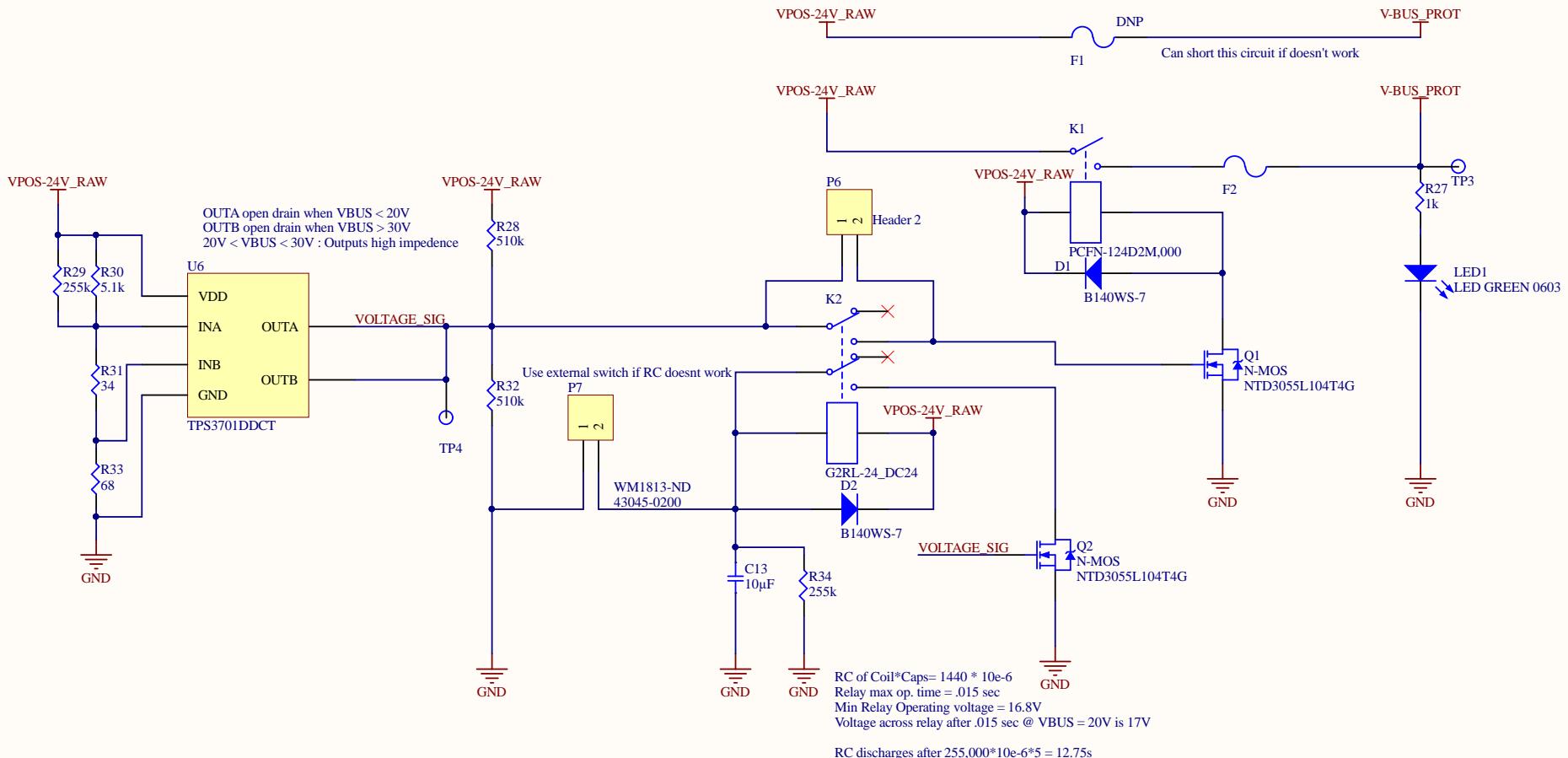
1

2

3

4

# BATTERY PROTECTION



Title <b>Battery Protection</b>			Badgerloop 133 Engineering Research Building Madison, WI 53715	<b>BADGER LOOP</b>
Size: A4	Number:	Revision:		
Date: 3/6/2021	Time: 11:18:19 PM	Sheet 17 of		
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\batt_protection.SchDoc				

1

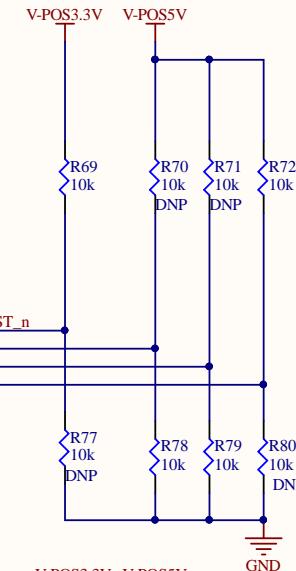
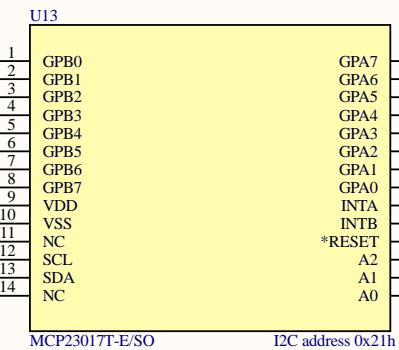
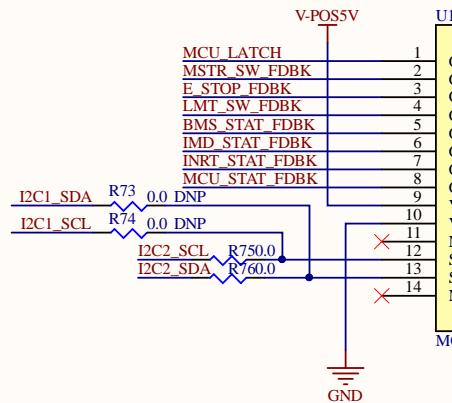
2

3

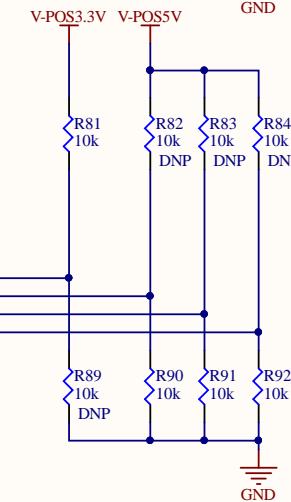
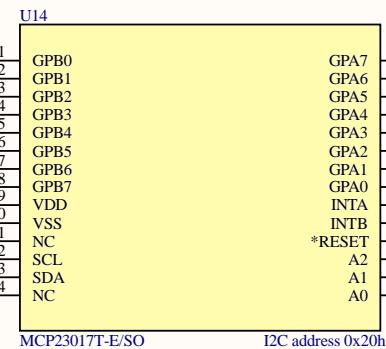
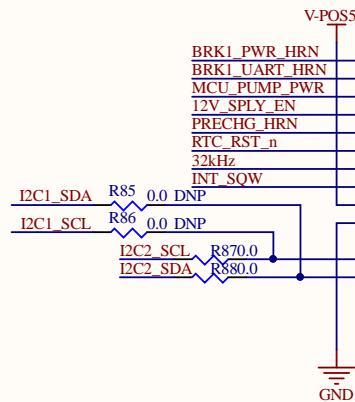
4

## GPIO

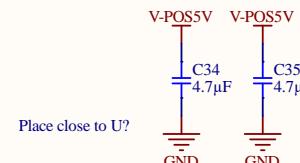
A



B



C



Place close to U?

Title: <b>GPIO</b>			<i>Badgerloop</i> 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:	Revision:	
Date: 3/6/2021	Time: 11:18:19 PM	Sheet 18 of	
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\gpio.SchDoc			<b>BADGER LOOP</b>

1

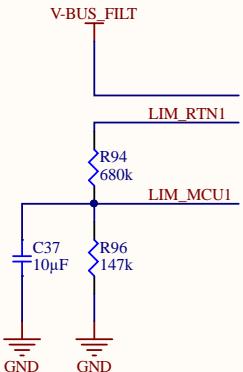
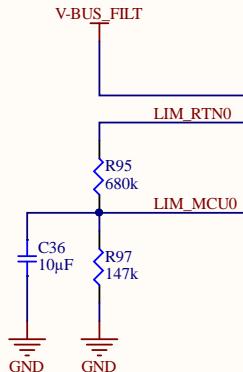
2

3

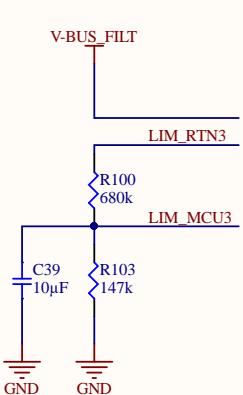
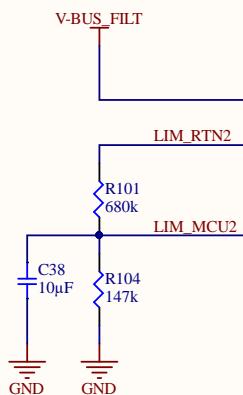
4

# Limit Switch Feedback

A

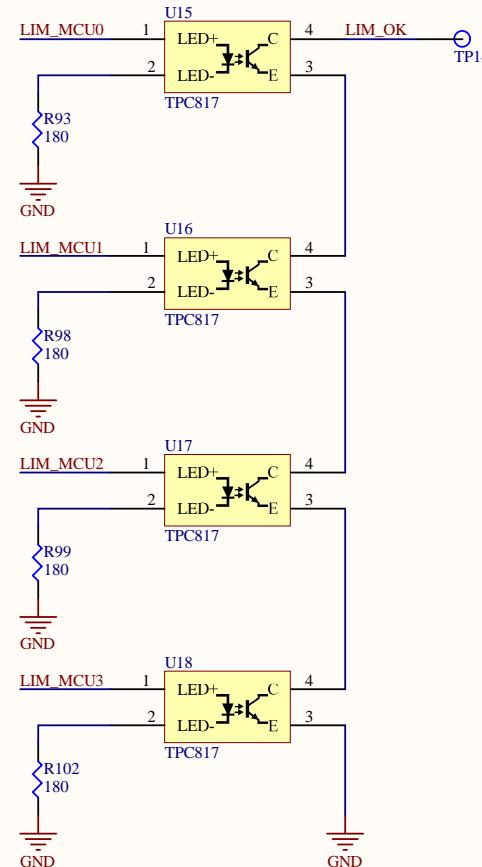


B



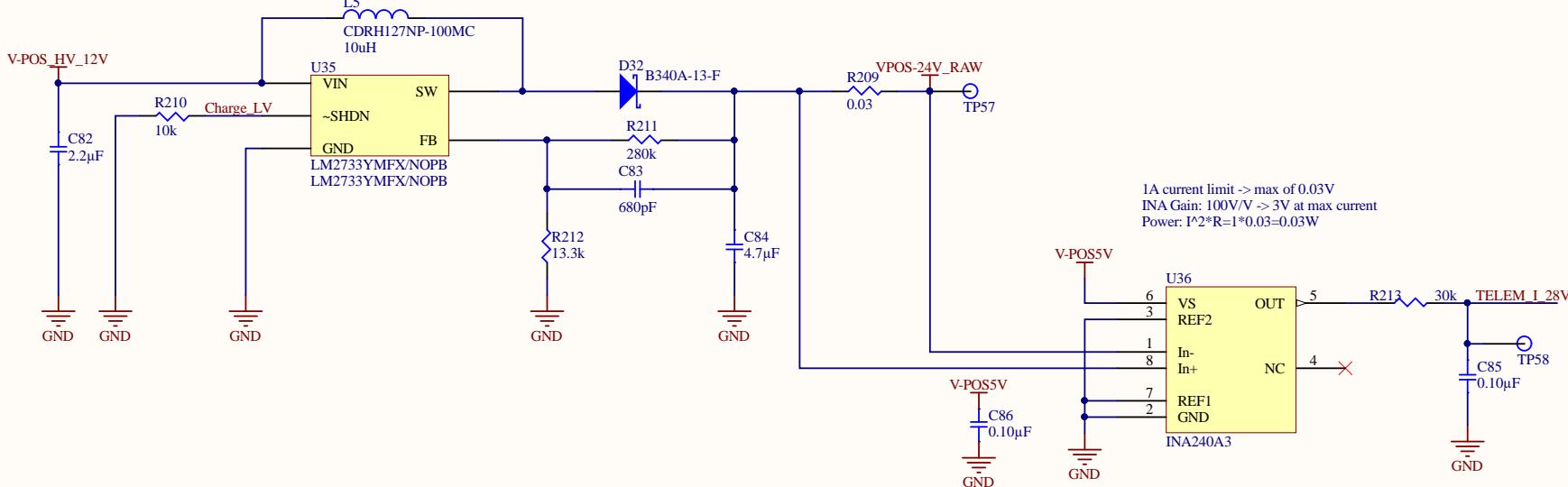
C

D



Title: <b>Limit Switches</b>	Badgerloop 133 Engineering Research Building Madison, WI 53715
Size: A4	Number:
Date: 3/6/2021	Revision:
File: C:\Users\Windows PC\Desktop\Badgerloop\git_repos\hardware\main_io\limit_switches.SchDoc	Time: 11:18:19 PM Sheet 19 of

# HV Batt 12V -> 28V



## CURRENT TELEMETRY

Title: <b>28V Boost</b>	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

