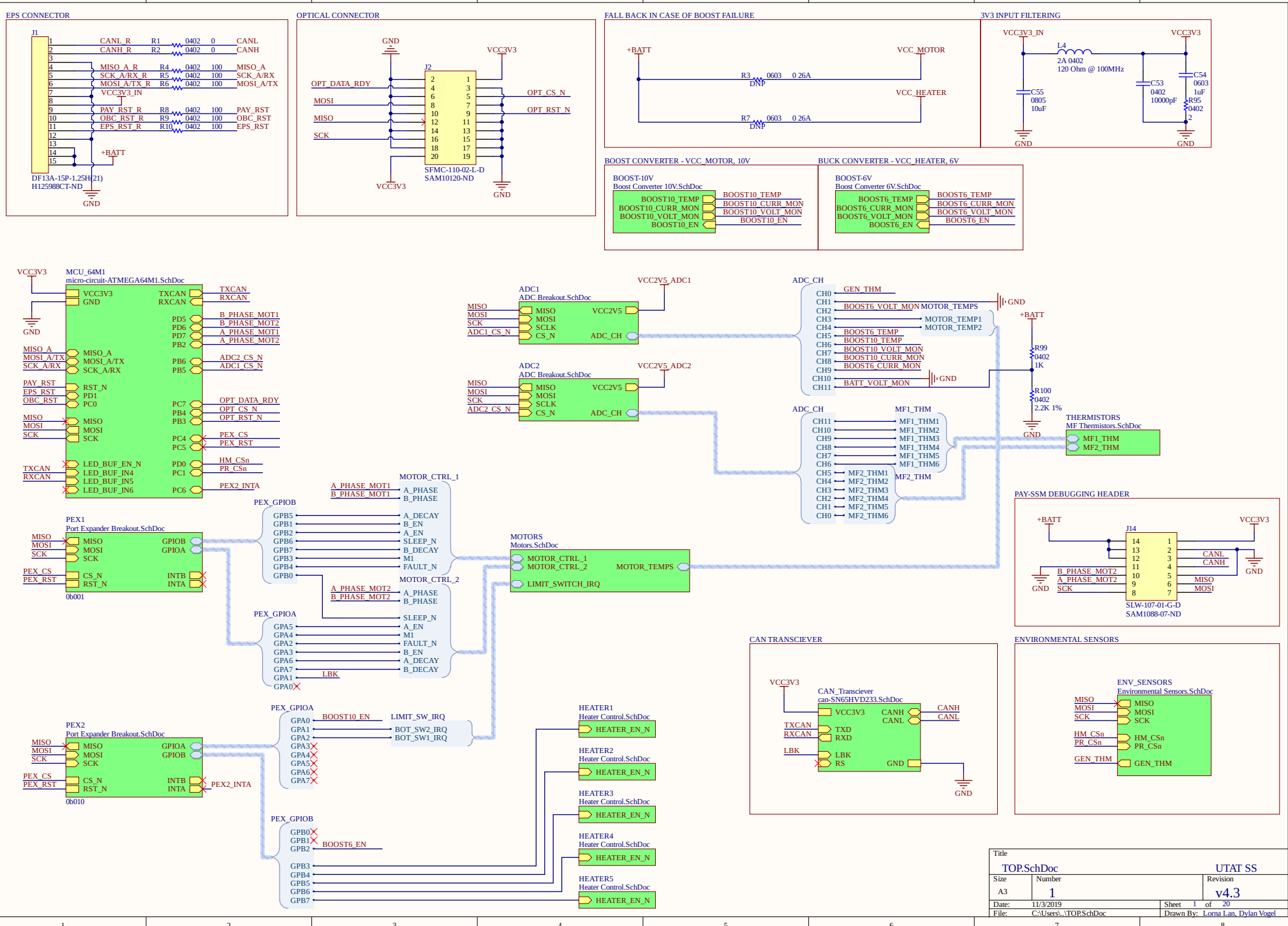
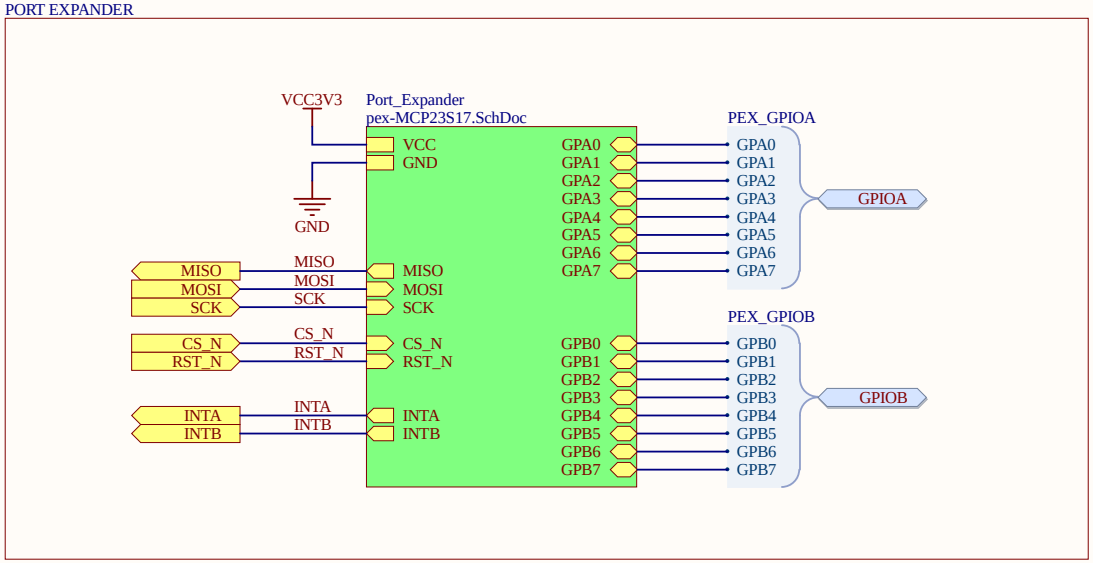

EPS CONNECTOR
J1
DF13A-15P-1.25H(21)
H125988CT-ND
OPTICAL CONNECTOR
J2
SFMC-110-02-L-D
SAM10120-ND
FALL BACK IN CASE OF BOOST FAILURE
3V3 INPUT FILTERING
BOOST CONVERTER - VCC_MOTOR, 10V
BOOST-10V
Boost Converter 10V.SchDoc
BUCK CONVERTER - VCC_HEATER, 6V
BOOST-6V
Boost Converter 6V.SchDoc
MCU_64M1
micro-circuit-ATMEGA64M1.SchDoc
ADC1
ADC Breakout.SchDoc
ADC2
ADC Breakout.SchDoc
ADC_CH
THERMISTORS
MF Thermistors.SchDoc
PEX1
Port Expander Breakout.SchDoc
0b001
PEX2
Port Expander Breakout.SchDoc
0b010
MOTOR_CTRL_1
MOTOR_CTRL_2
MOTORS
Motors.SchDoc
PEX_GPIOA
PEX_GPIOB
PAY-SSM DEBUGGING HEADER
J14
SLW-107-01-G-D
SAM1088-07-ND
CAN TRANSCIEVER
CAN_Transciever
can-SN65HVD233.SchDoc
ENVIRONMENTAL SENSORS
ENV_SENSORS
Environmental Sensors.SchDoc
HEATER1
HEATER2
HEATER3
HEATER4
HEATER5
Heater Control.SchDoc
Title
TOP.SchDoc
UTAT SS
Size
A3
Number
1
Revision
v4.3
Date:
11/3/2019
Sheet 1 of 20
File:
C:\Users\..\TOP.SchDoc
Drawn By:
Lorna Lan, Dylan Vogel

PORT EXPANDER

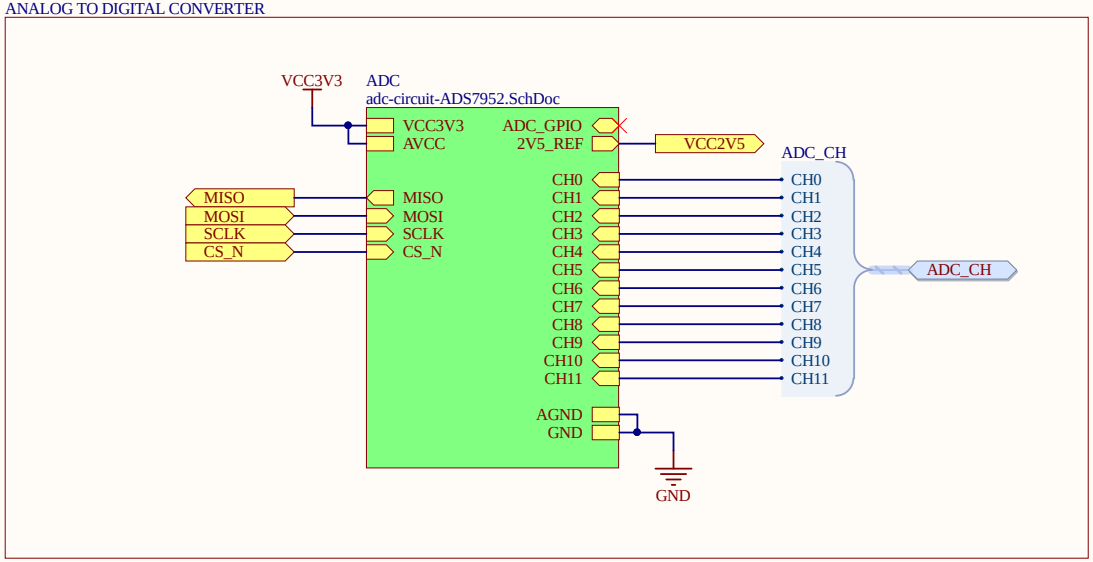


Breaks out the Port Expander GPIOs into harnesses

ADDRESS:

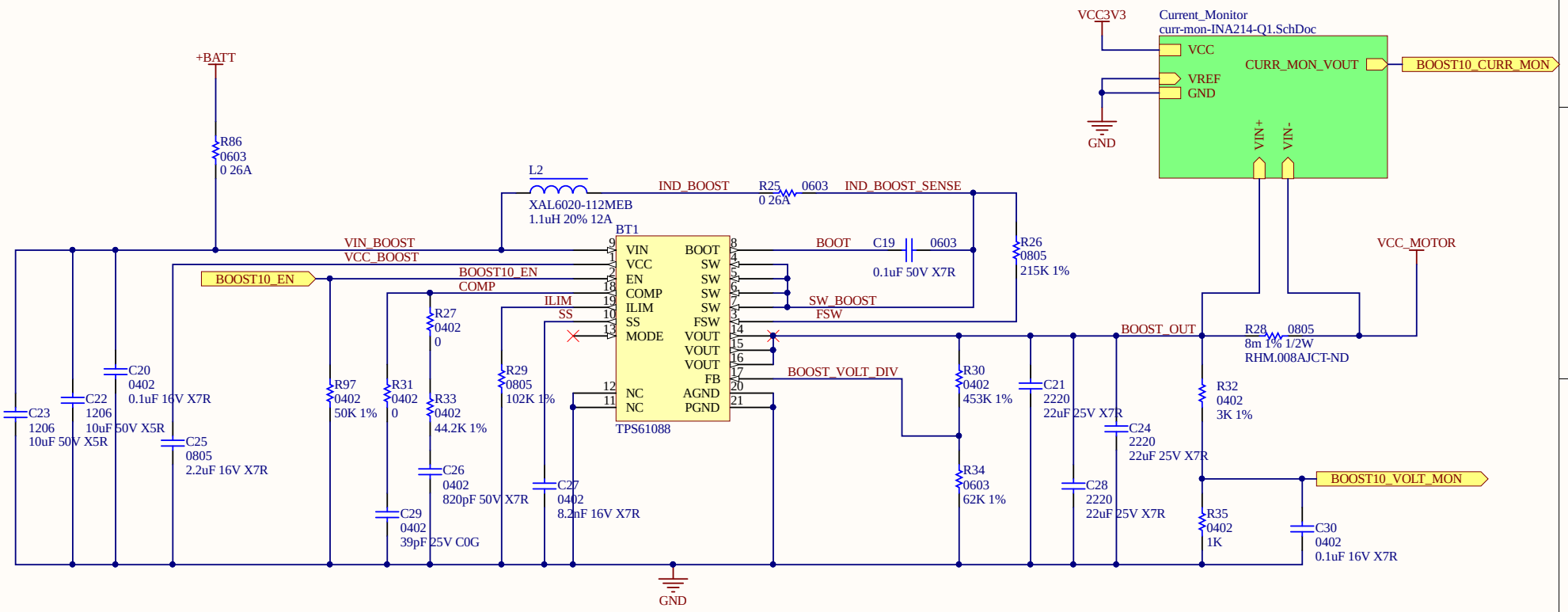
Title	Port Expander Breakout.SchDoc		UTAT SS
Size	Number		Revision
A4	5		v4.2
Date:	11/3/2019	Sheet 5	of 20
File:	C:\Users\..\Port Expander Breakout.SchDoc	Drawn By:	Dylan Vogel

ANALOG TO DIGITAL CONVERTER



Breaks out the ADC channels into harnesses

Title	ADC Breakout.SchDoc		UTAT SS
Size	Number		Revision
A4	7		v4.2
Date:	11/3/2019	Sheet 7	of 20
File:	C:\Users\..\ADC Breakout.SchDoc	Drawn By:	Lorna Lan, Dylan Vogel

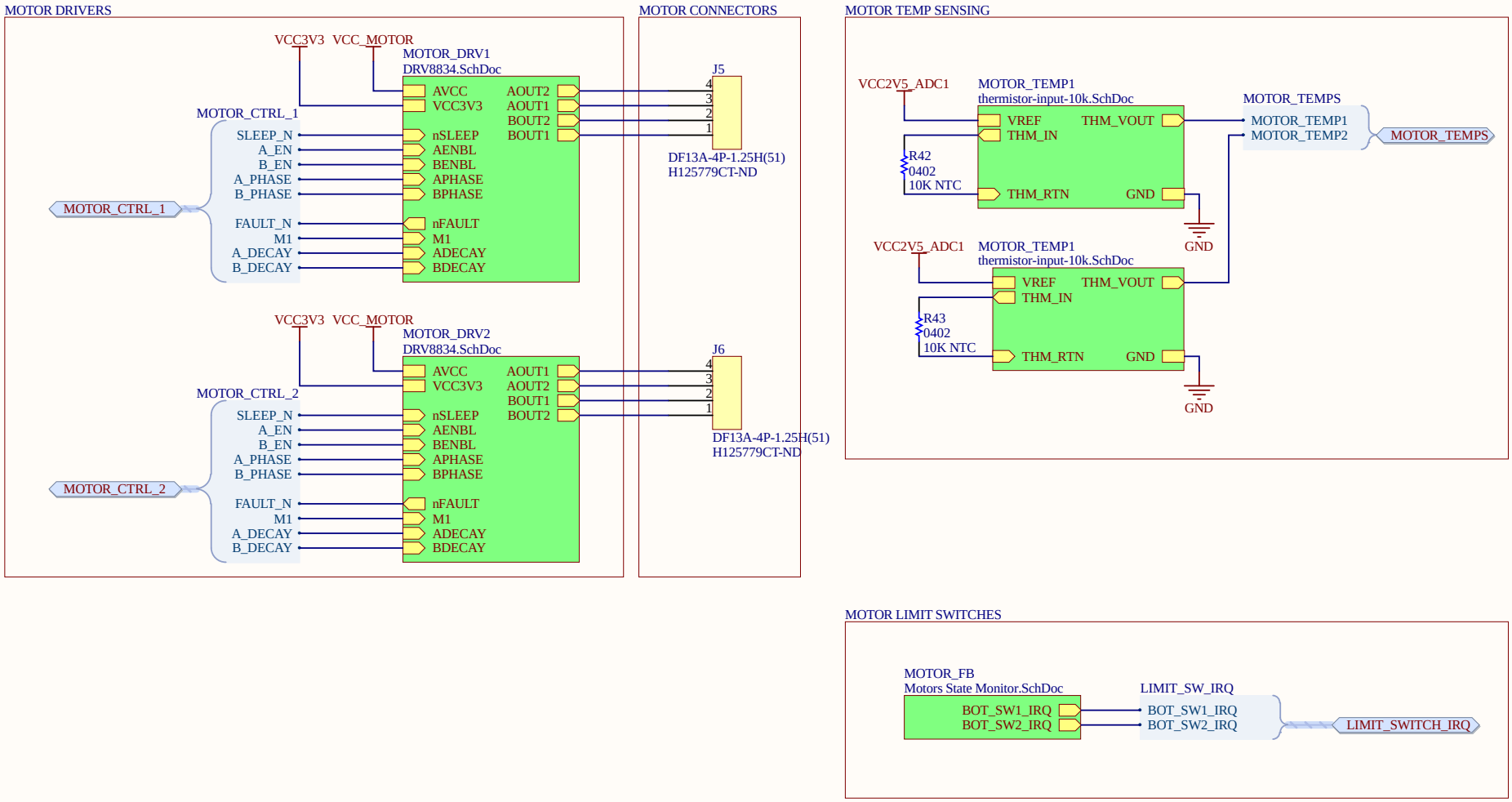


WEBENCH simulation link:

Parameters:
TPS61088RHLR 3.6V-4.2V to 10.00V @ 2.8A

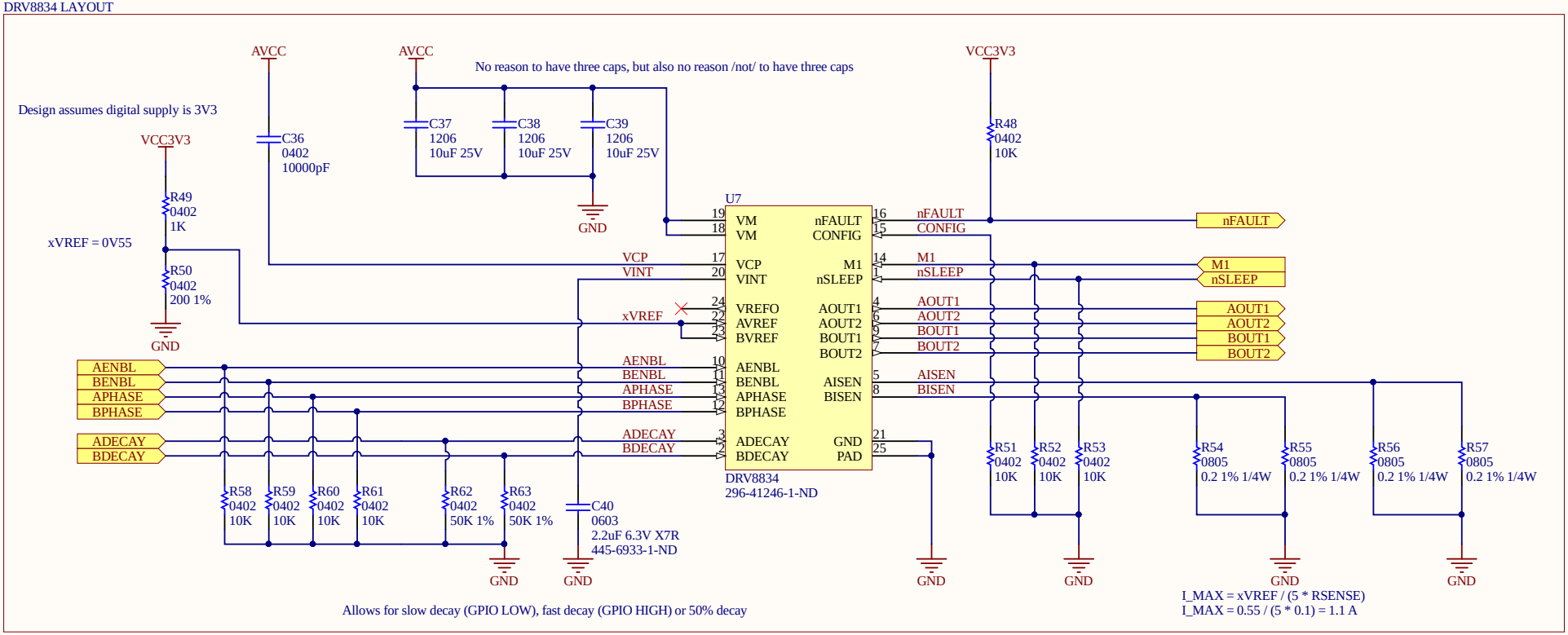
https://webench.ti.com/appinfo/webench/scripts/SDP.cgi?ID=CCD7917ED8455F42

Title	Boost Converter 10V.SchDoc		UTAT SS
Size	Number		Revision
A4	10		v4.3
Date:	11/3/2019	Sheet	10 of 20
File:	C:\Users\..\Boost Converter 10V.SchDoc	Drawn By:	Lorna Lan, Jaden Reimer



Title	Motors.SchDoc		UTAT SS
Size	A4	Number 11	Revision v4.2
Date:	11/3/2019	Sheet 11 of 20	
File:	C:\Users\..\Motors.SchDoc	Drawn By:	Lorna Lan, Dylan Vogel

DRV8834 LAYOUT



DRV8834 Motor Driver Notes

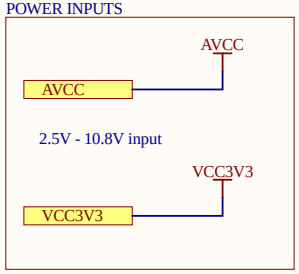
Datasheet: http://www.ti.com/lit/ds/symlink/drv8834.pdf

Indexer mode of this motor driver was tested to be not functioning, so everything is set in hardware to implement only the PHASE/ENABLE mode.

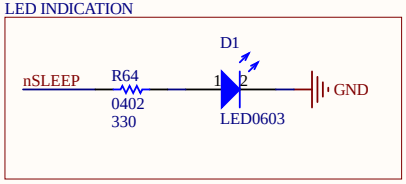
Implemented a voltage divider to set-up the xVREF voltage if want to modify xISEN and the resistor later. VREFO is left unconnected.

About decay settings: decay mode is selected by the voltage presented at the xDECAY pins in PHASE/ENABLE mode. It is also recommended with a pull-down to ground and a GPIO for setting.

POWER INPUTS

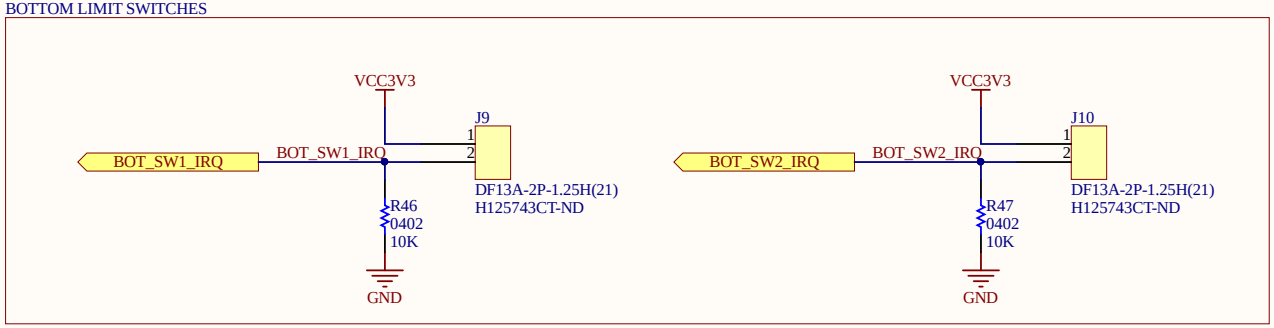


LED INDICATION



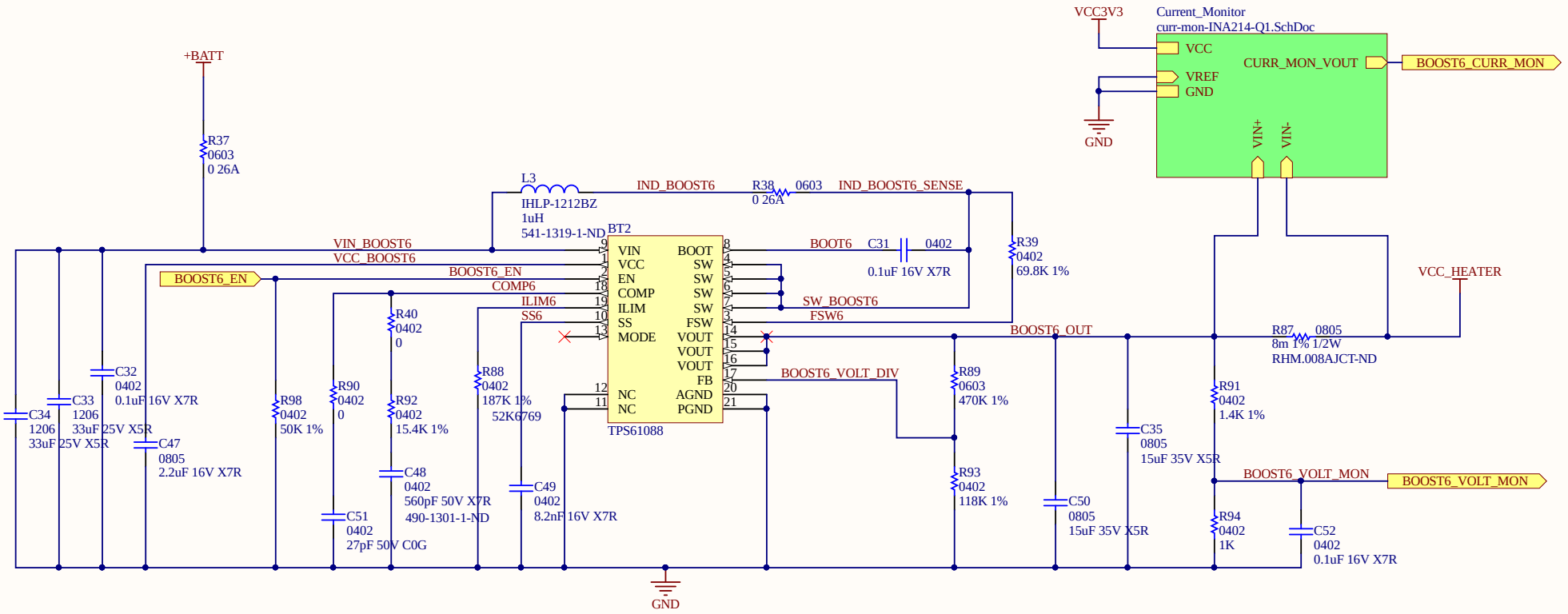
Title	DRV8834.SchDoc	UTAT SS
Size: A4	Number: 12	Revision: v4.2
Date: 11/3/2019	Sheet 12 of 20	
File: C:\Users\..\DRV8834.SchDoc	Drawn By: Lorna Lan, Dylan Vogel	

BOTTOM LIMIT SWITCHES

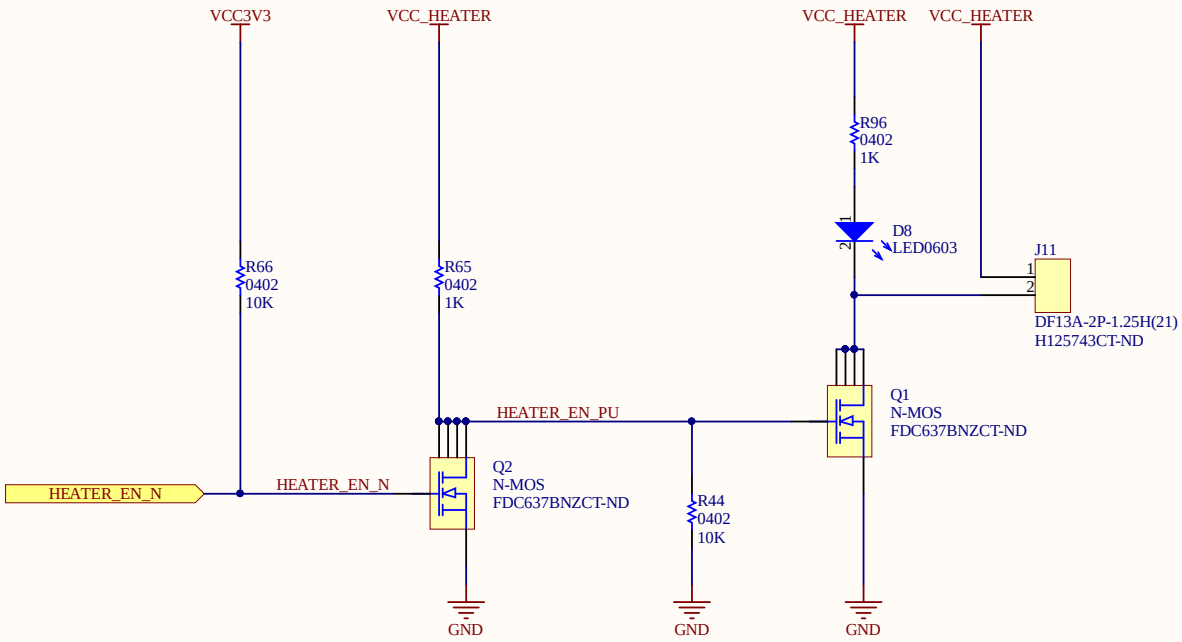


CONNECT TO NORMALLY-OPEN SWITCH FOR RISING EDGE INTERRUPT

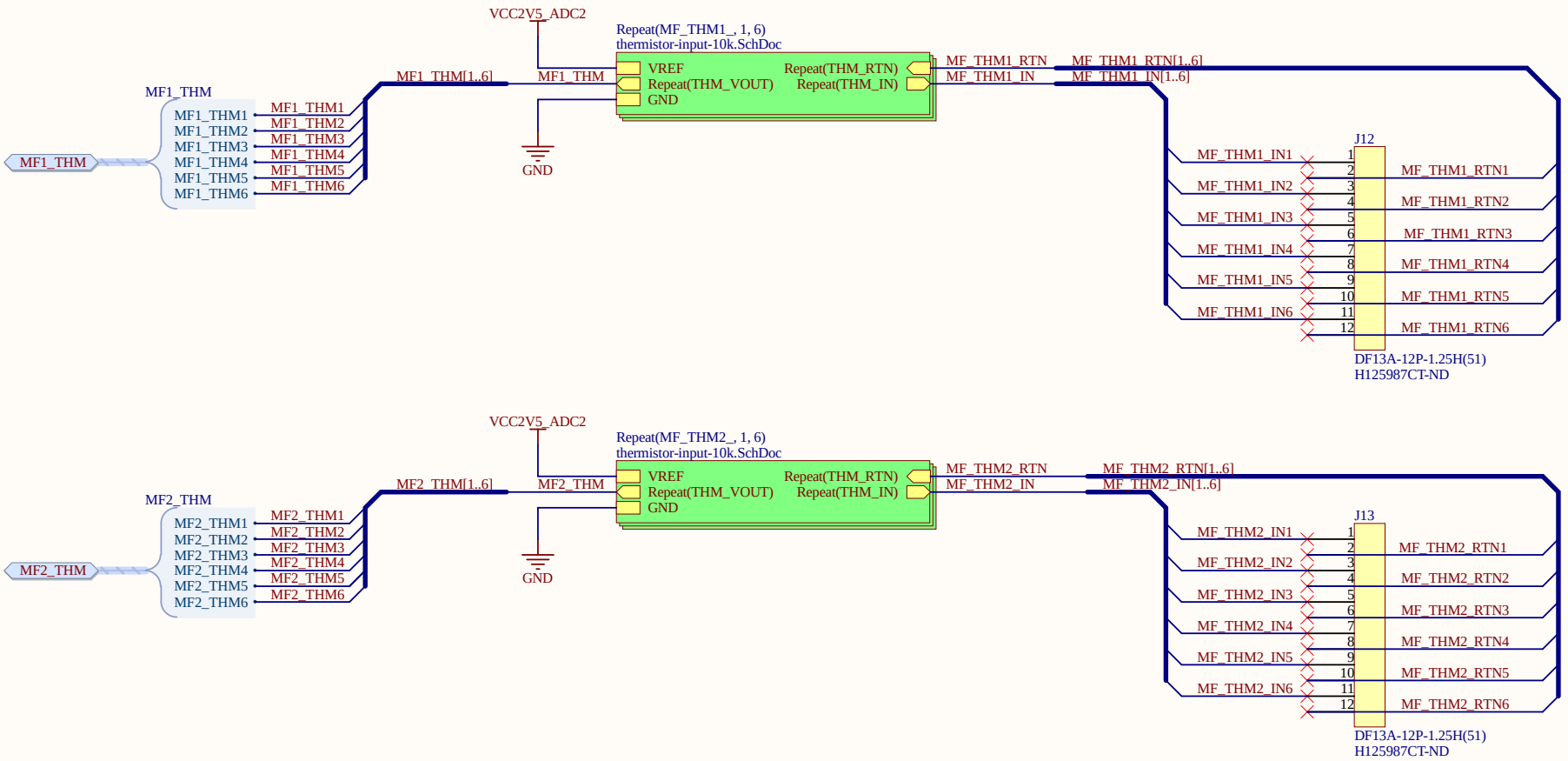
Title	Motors State Monitor.SchDoc		UTAT SS
Size	Number		Revision
A4	13		v4.2
Date:	11/3/2019	Sheet 13 of 20	
File:	C:\Users\..\Motors State Monitor.SchDoc	Drawn By:	Lorna Lan, Dylan Vogel



Title	Boost Converter 6V.SchDoc		UTAT SS
Size	Number		Revision
A4	14		v4.1
Date:	11/3/2019	Sheet 14 of 20	
File:	C:\Users\..\Boost Converter 6V.SchDoc	Drawn By:	Lorna Lan



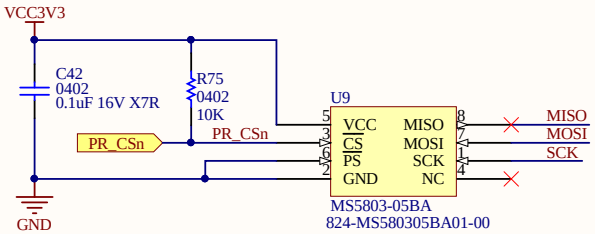
Title		
Heater Control.SchDoc		UTAT SS
Size: A4	Number: 15	Revision: v4.3
Date: 11/3/2019	Sheet 15 of 20	
File: C:\Users\..\Heater Control.SchDoc	Drawn By: Lorna Lan	



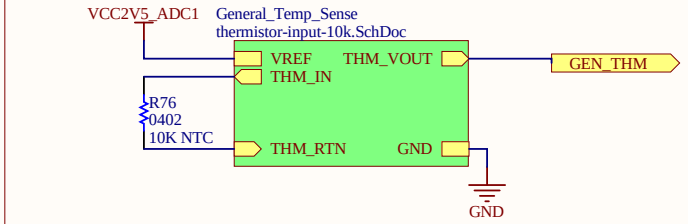
Title	MF Thermistors.SchDoc		UTAT SS
Size	Number		Revision
A4	17		v4.1
Date:	11/3/2019	Sheet 17	of 20
File:	C:\Users\..\MF Thermistors.SchDoc	Drawn By:	Lorna Lan, Dylan Vogel

Sensor SPI Line

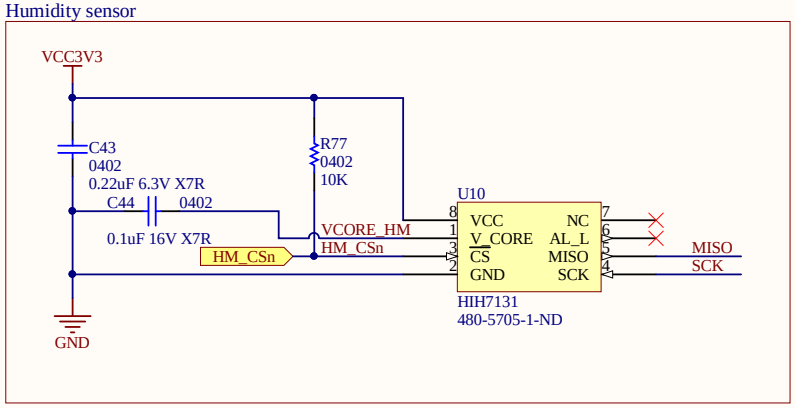
Pressure Sensor



General/Ambient Temperature Thermistor

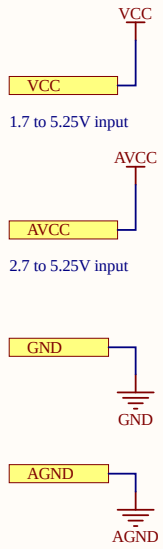


Humidity sensor

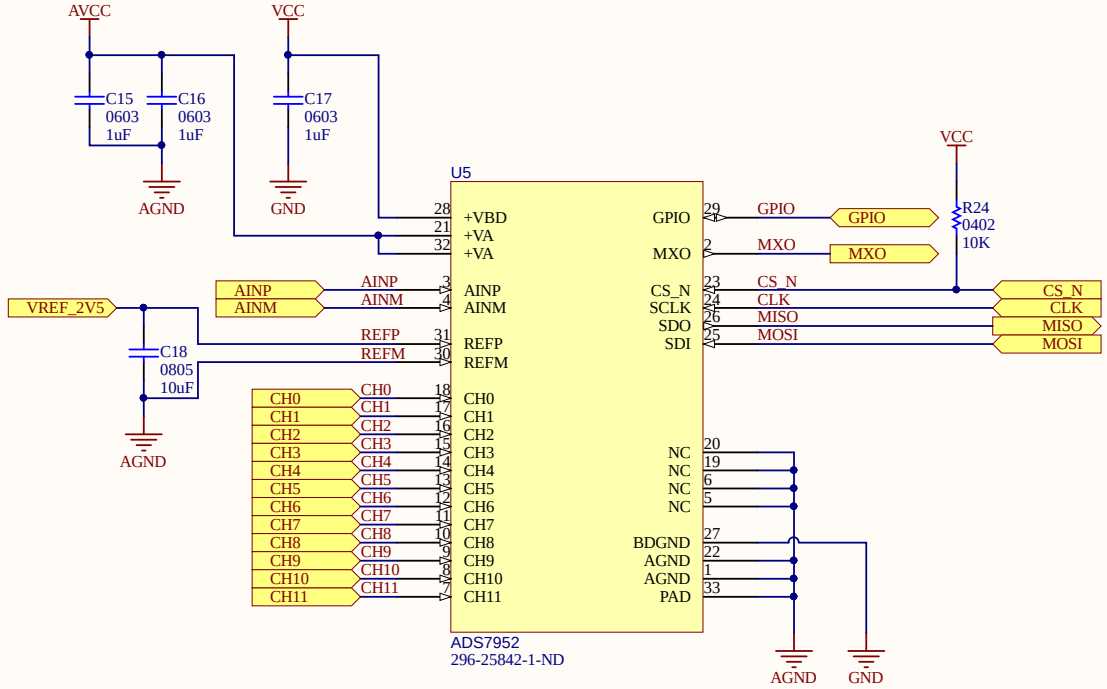


Title	Environmental Sensors.SchDoc		UTAT SS
Size	Number		Revision
A4	19		v4.2
Date:	11/3/2019	Sheet 19 of 20	
File:	C:\Users\..\Environmental Sensors.SchDoc	Drawn By:	Dylan Vogel, Lorna Lan

POWER INPUTS
AVCC >= VCC (pg 51)



See pg 53, each +VA pin should have it's own 1uF



12 CHANNEL ADC

Title	adc-ADS7952.SchDoc	UTAT SS
Size: A4	Number: PCBS-COMMON	Revision: 1.1
Date: 11/3/2019	Sheet * of *	
File: C:\Users\..\adc-ADS7952.SchDoc	Drawn By: Dylan Vogel	

POWER PORTS

AVCC >= VCC (pg 51)

AVCC

2.7 to 5.25V input

VCC3V3

1.7 to 5.25V input

VREF_2V5

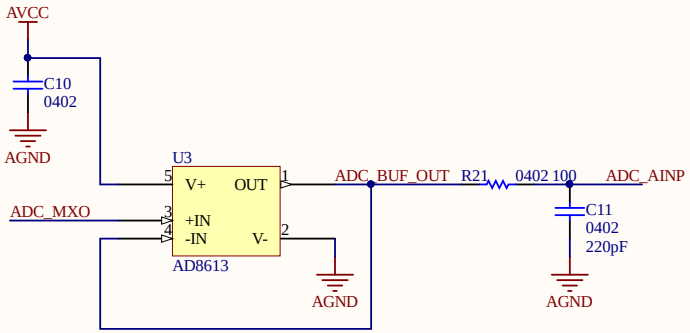
WARNING: cannot source > 10mA

AGND

GND

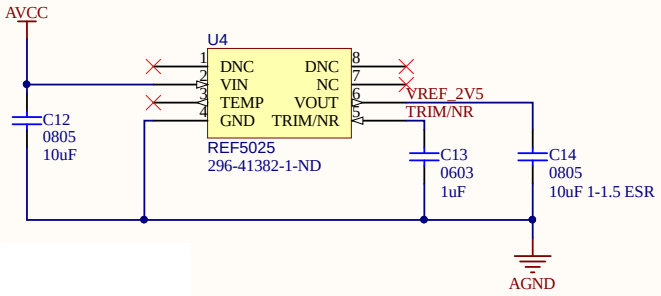
ADC INPUT BUFFER

See pg. 50 for discussion of unity buffer design procedure

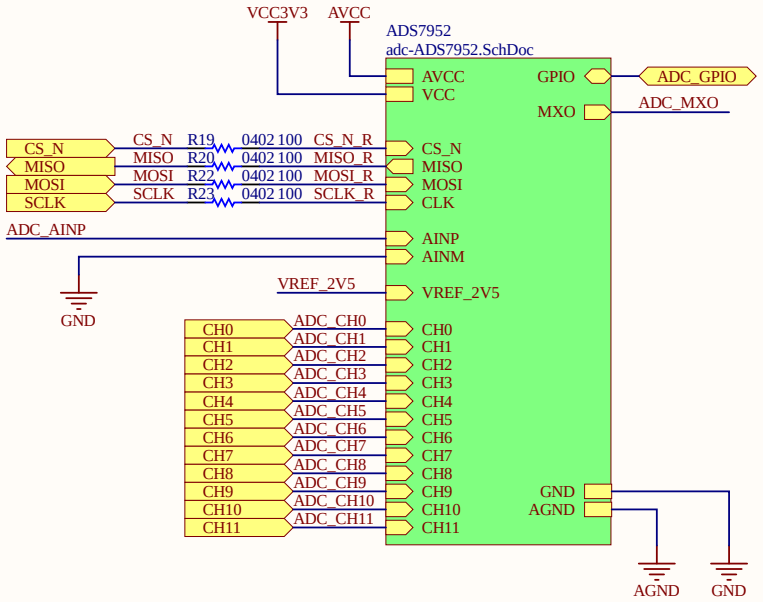


2V5 REFERENCE

Output cap should have ESR from 1 - 1.5 ohm (see pg. 21)



ADC



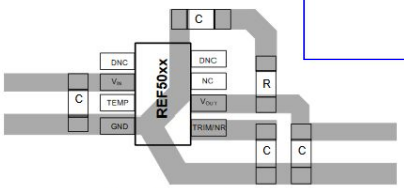


Figure 44. Layout Example

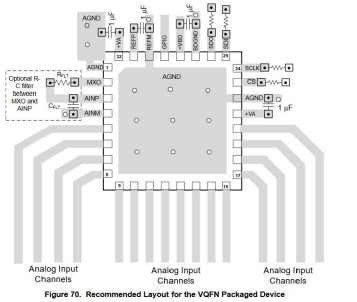
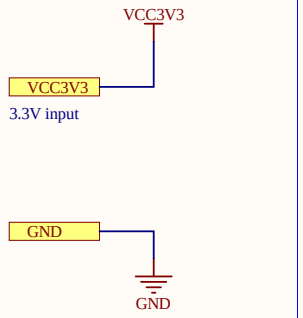


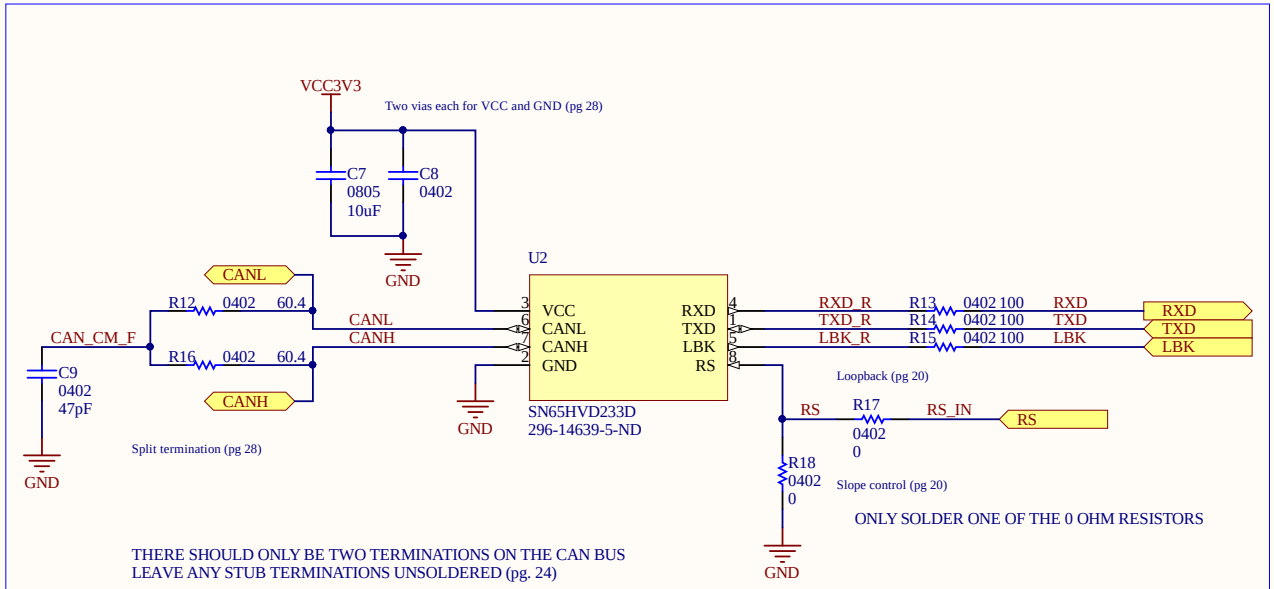
Figure 70. Recommended Layout for the VQFN Packaged Device

This schematic implements the ADS7952 analog-to-digital converter with a 2.5V reference and a unity-gain buffer on the output of the internal multiplexer.
- Recommended input impedance should be < 1K. Higher source impedances possible with slower sampling.
- Breaks out 2V5 for use as reference outside the circuit
- All necessary bypassing and pull-ups implemented in the ADS7952 schematic
- In most low-performance applications, AVCC and VCC can be tied together
- In the layout, the pins tied to AGND should be put on a local GND pour and then tied to the global ground plane with low-impedance.
- 100 ohm resistors on the SPI input help to isolate the ADC from digital noise

Title	adc-circuit-ADS7952.SchDoc	UTAT SS
Size: A4	Number: PCBS-COMMON	Revision: 1.1
Date: 11/3/2019	Sheet * of *	
File: C:\Users\..\adc-circuit-ADS7952.SchDoc	Drawn By: Dylan Vogel	

POWER INPUT





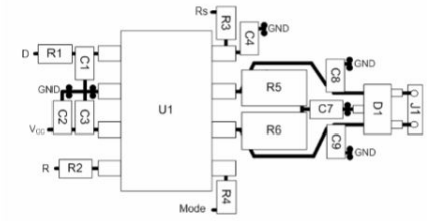


Figure 41. Layout Example Schematic

See pg. 28 of the datasheet for layout guidelines

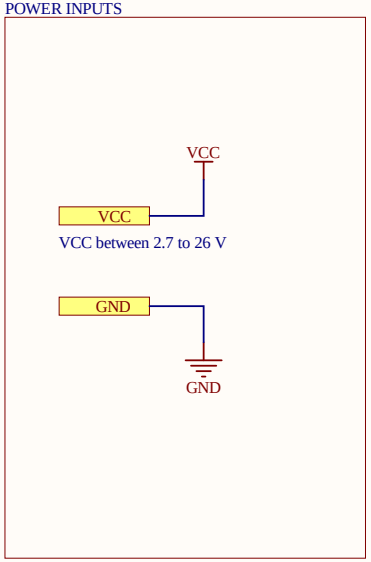
This schematic implements the SN65HVD233 CAN transciever with loopback control and two options for slope control.

A 0 Ohm resistor can be soldered to GND to permanently put the device in high speed mode (20 V / us slew), or a 0 Ohm resistor can be soldered to the RS port to control the device via an external microcontroller. Connecting the RS pin to a microcontroller allows the device to be put into low-power mode by setting the RS pin high.

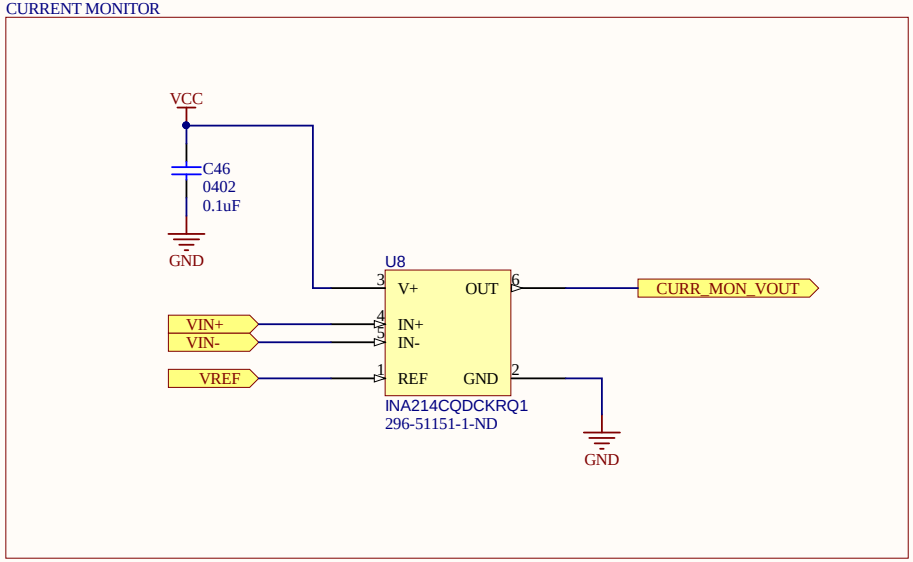
- Device is meant to be used in a 3.3 V system
- 100 Ohm current limiting resistors placed on the digital lines to minimize digital noise to the device
- Only two CAN transcievers on the bus should have 120 ohm terminations. Other devices should be placed on 'stub' networks where the terminations are left unsoldered

Title	can-SN65HVD233.SchDoc		UTAT SS
Size	Number		Revision
A4	PCBS-COMMON		1.2
Date:	11/3/2019	Sheet * of *	
File:	C:\Users\..\can-SN65HVD233.SchDoc	Drawn By:	Dylan Vogel

POWER INPUTS



CURRENT MONITOR



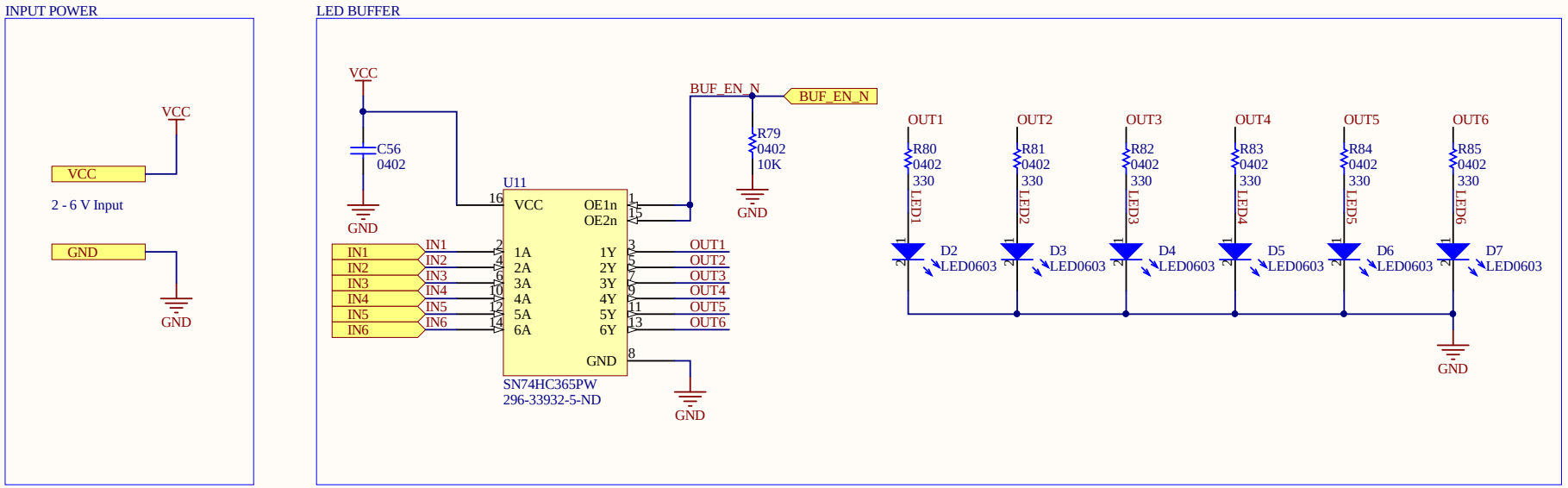
This schematic implements the INA214-Q1 automotive grade, voltage output, high- or low-side, bidirectional, zero-drift current shunt monitor

Application Information:

- This amplifier has an internal gain of 100x
- Place a small value current sense resistor (1 -> 10 mOhm) in series with the current you're trying to monitor. Connect VIN+ of the current monitor to the positive terminal of the resistor, and VIN- to the negative terminal.
- Assume the worst-case input voltage offset is 100uV. This allows you to calculate your expected measurement error. No strict guideline on what this should be, but if your full-scale current generates a voltage of 10mV across your sense resistor, that's 1% error. Typical error will be lower than this.

- For unidirectional operation (current in one direction) connect VREF to GND
- For bidirectional operation, UTAT reccommends connecting VREF to the stable 2.5V reference you probably already use for your ADC. Pop a 0.1uF on your VREF connection in that case.
- To calculate your current range for bidirectional, understand that forward current will cause VOUT to rise from 2.5 V up to VCC - 0.2 V. Reverse current will cause VOUT to drop from 2.5V to GND. Divide this voltage swing in each direction by (100 * R_sense) to figure out your max current

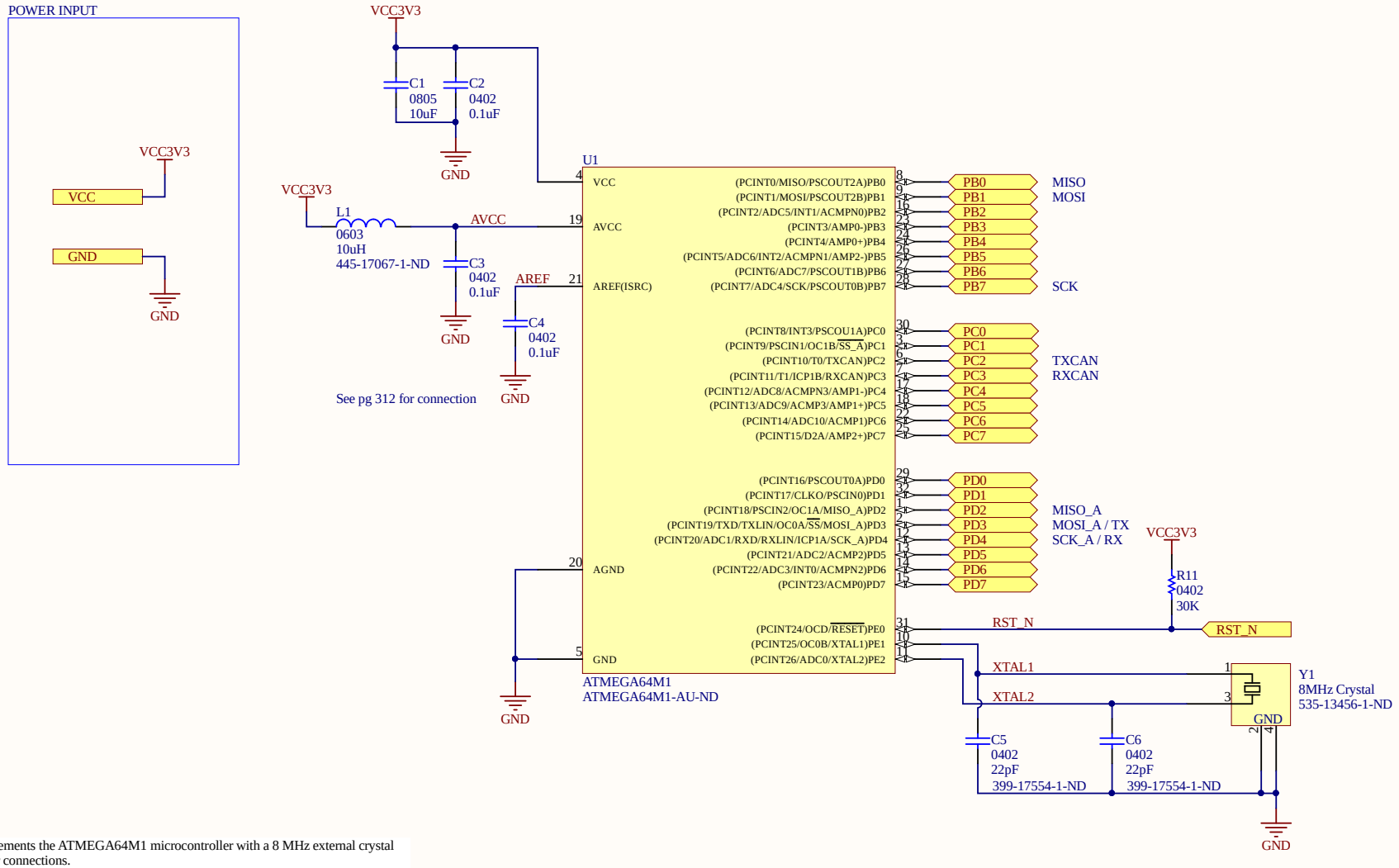
Title	curr-mon-INA214-Q1.SchDoc		UTAT SS
Size	A4	Number PCBS-COMMON	Revision 1.0
Date:	11/3/2019	Sheet *	of *
File:	C:\Users\..\curr-mon-INA214-Q1.SchDoc	Drawn By:	J. Reimer, D. Vogel



This schematic implements the SN74HC365PW non-inverting, tri-state hex buffer as an LED monitoring circuit. Connecting a signal to IN[1:6] will light up the corresponding LED on OUT[1:6].

- The BUF_EN_N input can be connected to a mircocontroller to control the buffer. An input HIGH will set the outputs to high-impedance and disable the LEDs.
- In the schematic symbol which references this schematic sheet, parameters LED[1:6] can be added to specify the colour of each LED. See the micro-circuit common sheet for an example of this.
- Unconnected inputs should be grounded if you don't want random flickering of the LEDs.

Title	led-monitoring-SN74HC365PW.SchDoc		UTAT SS
Size	Number		Revision
A4	PCBS-COMMON		1.1
Date:	11/3/2019	Sheet * of *	
File:	C:\Users\..\led-monitoring-SN74HC365PW.SchDoc	Drawn By:	Dylan Vogel

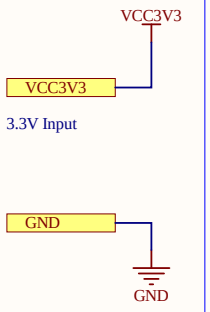


This schematic implements the ATMEGA64M1 microcontroller with a 8 MHz external crystal and necessary power connections.

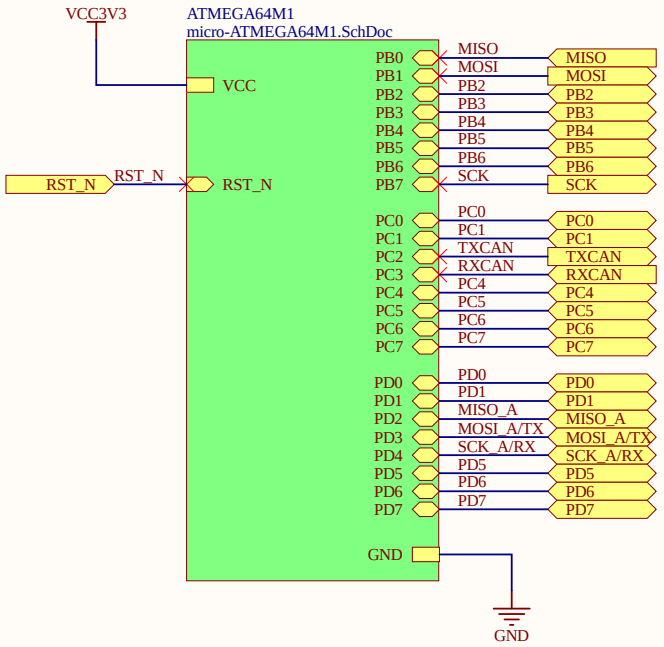
- Crystal is connected in a Pierce configuration, values of the capacitors were calculated based on the capacitance of the crystal and ESR.
- I would read through 18.5.2 and 18.6.2 of the complete 64M1 datasheet if you're interested in the motivation behind the ADC input connections. They recommend connecting AVCC through a RC lowpass network to minimize noise.
- If the ADC functionality of the device is used, either AVCC or the internal 2.56 V source can be seleted in software as the reference voltage.

Title	micro-ATMEGA64M1.SchDoc	UTAT SS
Size: A4	Number: PCBS-COMMON	Revision: 1.1
Date: 11/3/2019	Sheet * of *	
File: C:\Users\..\micro-ATMEGA64M1.SchDoc	Drawn By: Dylan Vogel	

POWER INPUTS

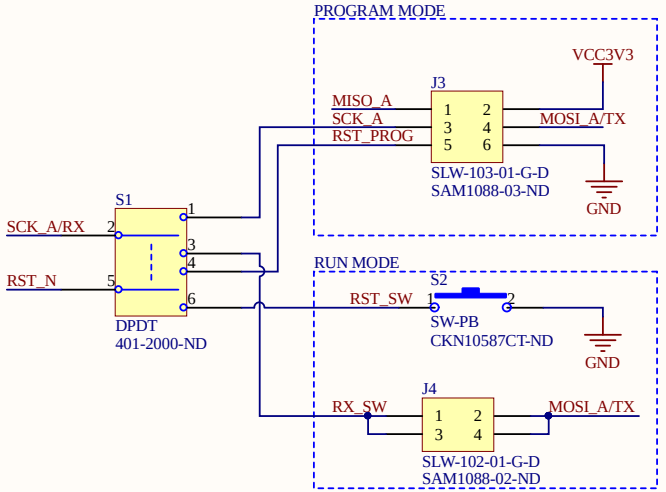


ATMEGA32M1

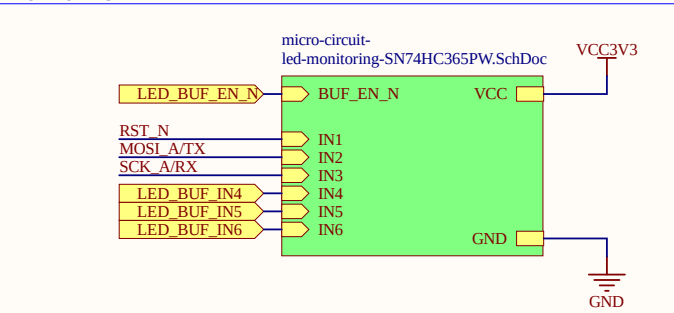


Specific No-ERCs placed for I/O Port and Bidirectional Sheet Entry

MODE SELECT CIRCUITRY



LED MONITORING

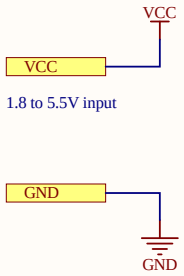


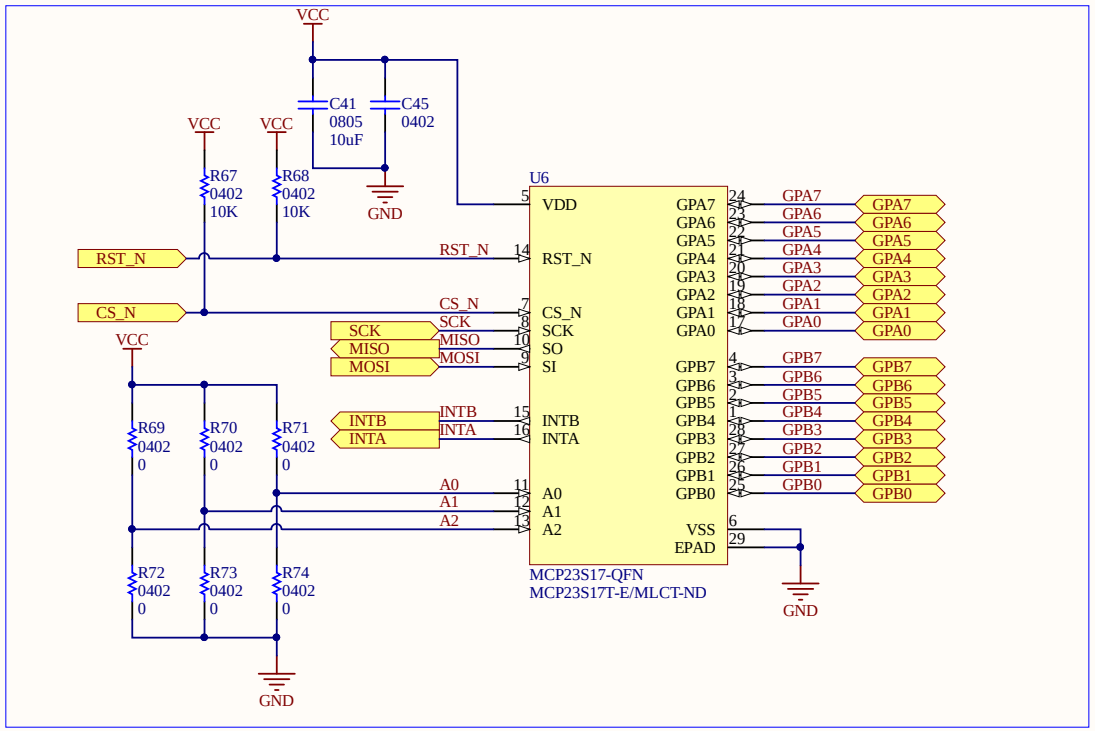
This schematic extends the functionality already included in the micro-ATMEGA32M1 schematc, adding a mode select switch, programming header, reset button and LED indication for TX, RX and RSTn.

- IN[4:6] of the LED buffer have been left unconnected, but are broken out on ports LED_BUF_IN[4:6]. They can be connected in the schematic which includes this sheet to monitor up to an additional 3 lines. Highly recommend more blinking lights.

Title	micro-circuit-ATMEGA64M1.SchDoc		UTAT SS
Size	Number		Revision
A4	PCBS-COMMON		1.1
Date:	11/3/2019	Sheet *	of *
File:	C:\Users\..\micro-circuit-ATMEGA64M1.SchDoc	Drawn By:	Dylan Vogel

POWER INPUTS





ADDRESS:

CHANNEL SELECTION

ONLY SOLDER ONE 0 OHM FROM EACH PAIR
PEX ADDRESS = A2 A1 A0
VCC == 1 GND == 0

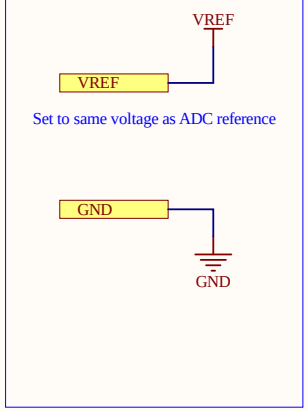
This schematic implements the MCP23S17 SPI port expander, and does some common-sense things like adding a bypass capacitor to the power supply and pull-up resistors to RST_N and CS_N.

Multiple port expanders can be connected to the same CS_N line, and accessed via a device address that is used during software communication. This address is set in hardware via the A2, A1 and A0 pins. Soldering a 0 ohm resistor to VCC will set that bit to 1, and soldering to GND will set that bit to 0.

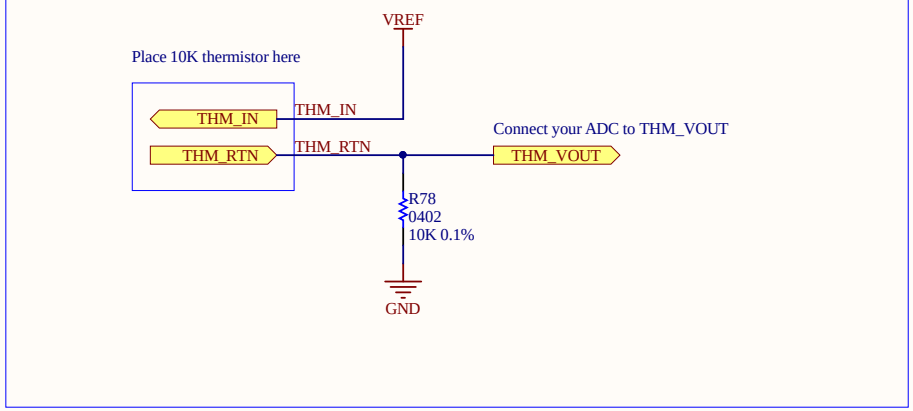
In the schematic which includes this file, you should make some note of the relevant hardware address that should be soldered during manufacturing.

Title	pex-MCP23S17.SchDoc	UTAT SS
Size: A4	Number: PCBS-COMMON	Revision: 1.1
Date: 11/3/2019		Sheet * of *
File: C:\Users\..\pex-MCP23S17.SchDoc		Drawn By: Dylan Vogel

POWER INPUTS



THERMISTOR



Title	thermistor-input-10k.SchDoc		UTAT SS
Size	Number		Revision
A4	PCBS-COMMON		1.2
Date:	11/3/2019	Sheet *	of *
File:	C:\Users\..\thermistor-input-10k.SchDoc	Drawn By:	B. Almeida, D. Vogel