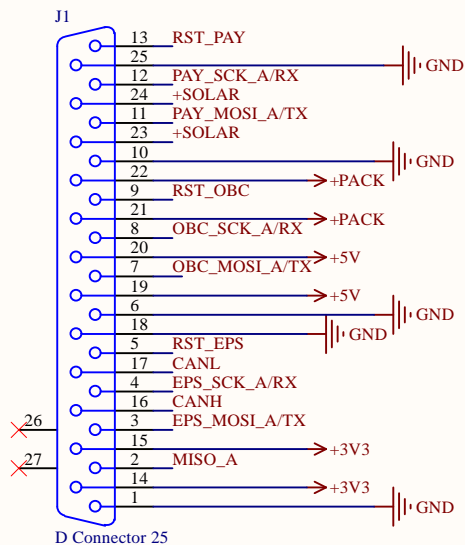
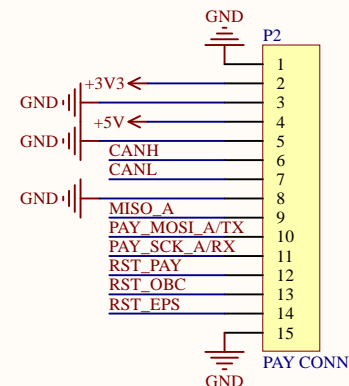
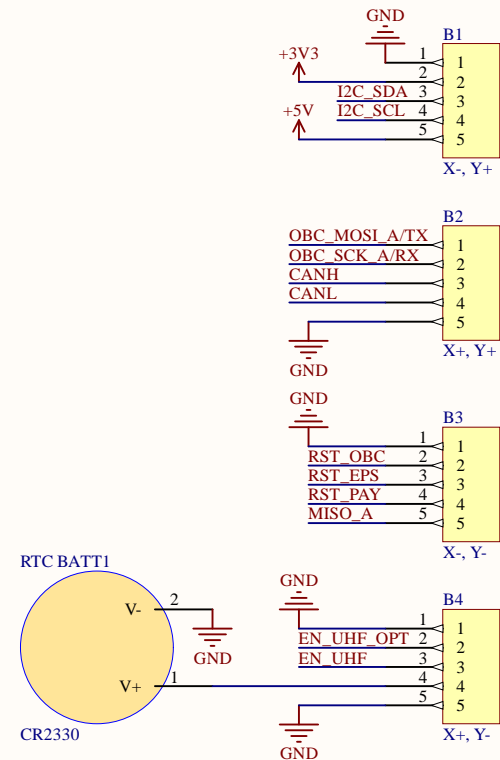
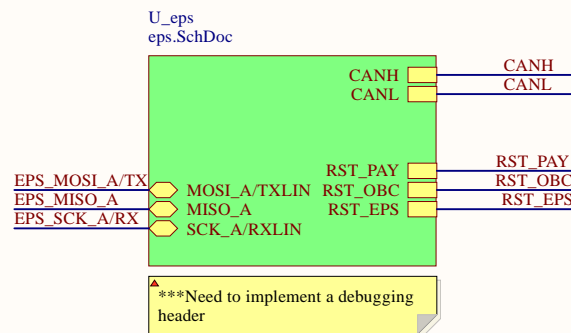
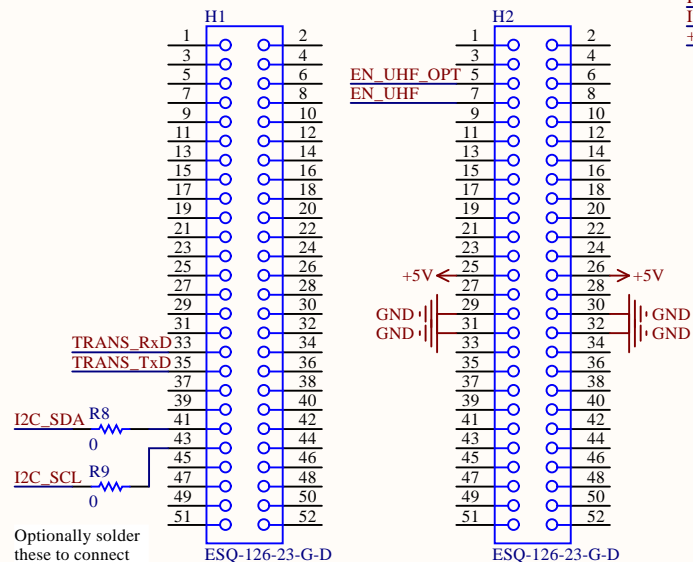
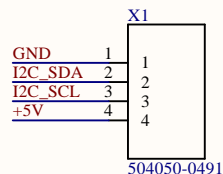


4-pin Molex connector to antenna
for I2C deployment command



Title		
Size	Number	Revision
A4		
Date:	2018-12-05	Sheet of
File:	C:\Users\...\bus-main.SchDoc	Drawn By:

A

A

B

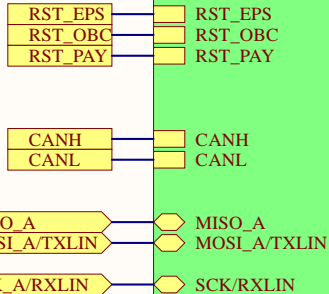
B

C

C

D

D



ADC_BBI
ADC_BBV

U_eps_bb
eps_bb.SchDoc

3V3IOUT
3V3OUT

▲ Connecting the voltage outputs of these two together for now, same for the boost. Can't tell if one fails.

BOOST_IOUT
bt_current_monitor

5IOUT
BT_OUT

U_eps_bt
eps_bt.SchDoc

BT_OUT
5VOUT

ADC_BTI
ADC_BTV

U_eps_batt
eps_batt.SchDoc

ADC_IPACK
ADC_+PACK

IPACK
VPACK

▲ +PACK is the internal plane, it is after the battery protection circuit and the batteries. +BATT is between the protection and the batteries

SHUNT+Y
SHUNT-Y

U_eps_pv
eps_pv.SchDoc

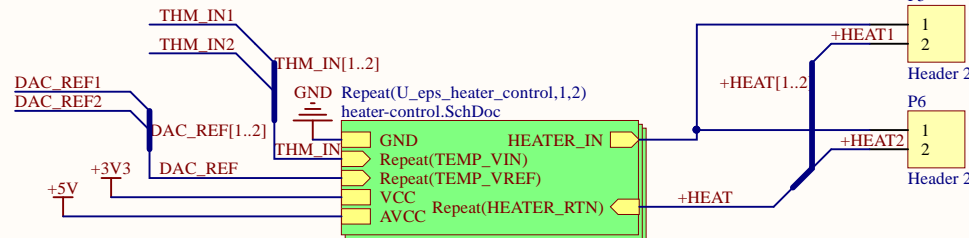
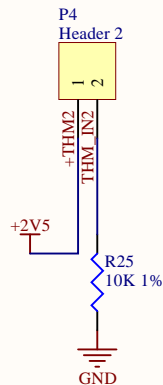
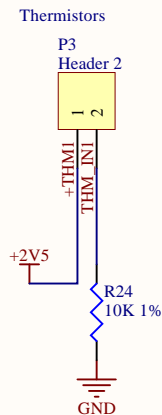
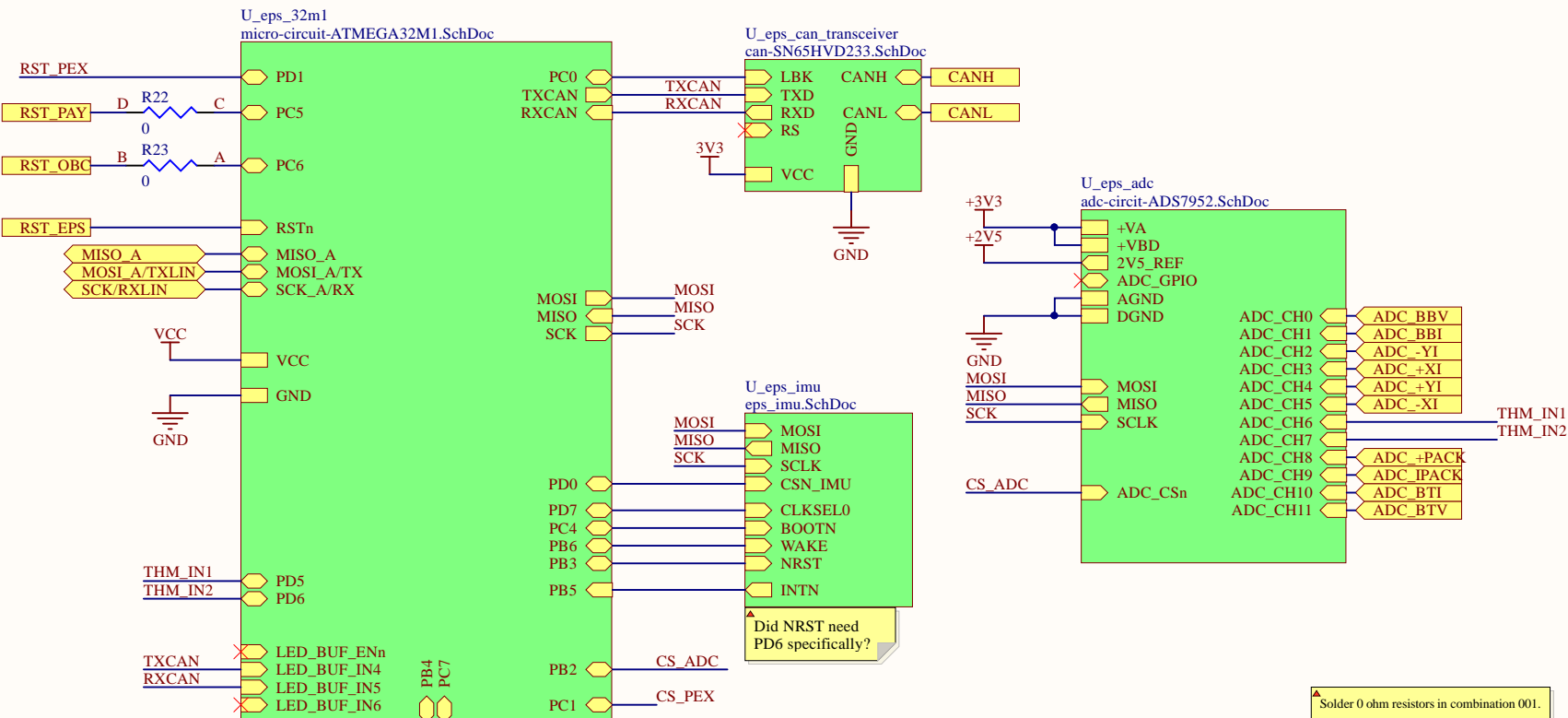
ADC_-YI
ADC_+YI
ADC_-XI
ADC_+XI

-YI -YVgs
+YI +YVgs
-XI -XVgs
+XI +XVgs

SHUNT+X
SHUNT-X

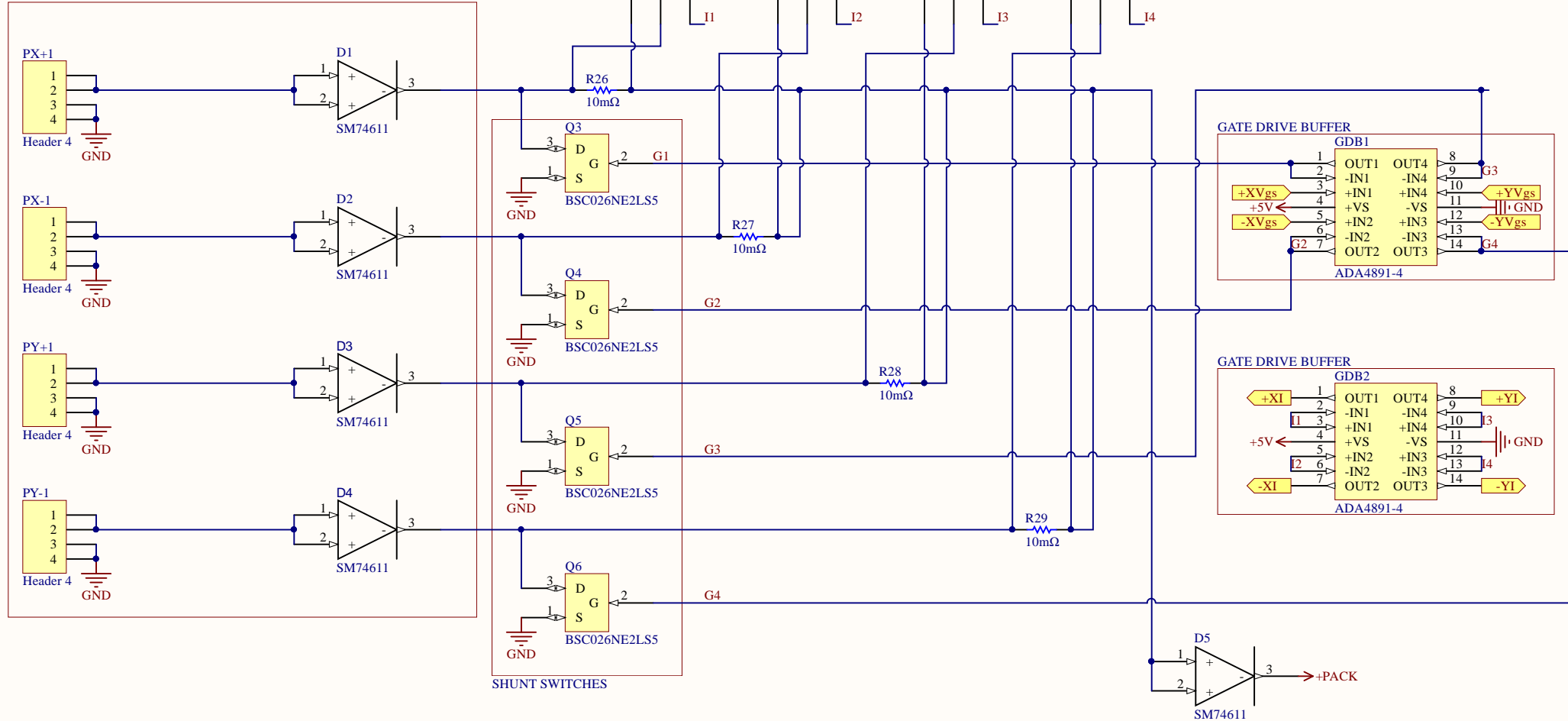
Title			
Size	Number		Revision
A			
Date:	2018-12-05	Sheet	of
File:	C:\Users\...\eps.SchDoc	Drawn By:	

Why are there 0 ohms here and does EPS need one?



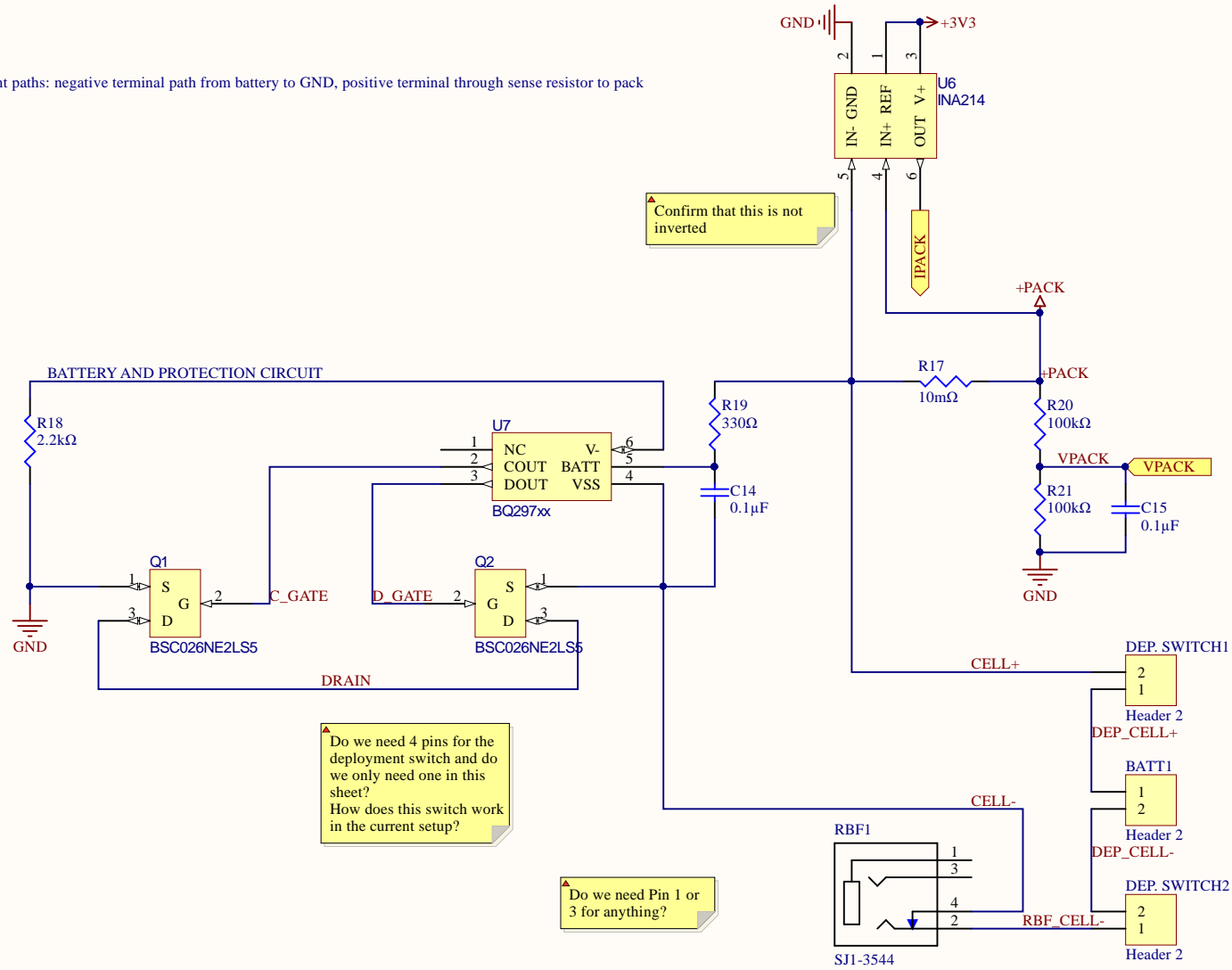
Title		
Size	Number	Revision
A4		
Date:	2018-12-05	Sheet of
File:	C:\Users\...\eps_digital.SchDoc	Drawn By:

SOLAR PANEL INTERFACE AND DIODES

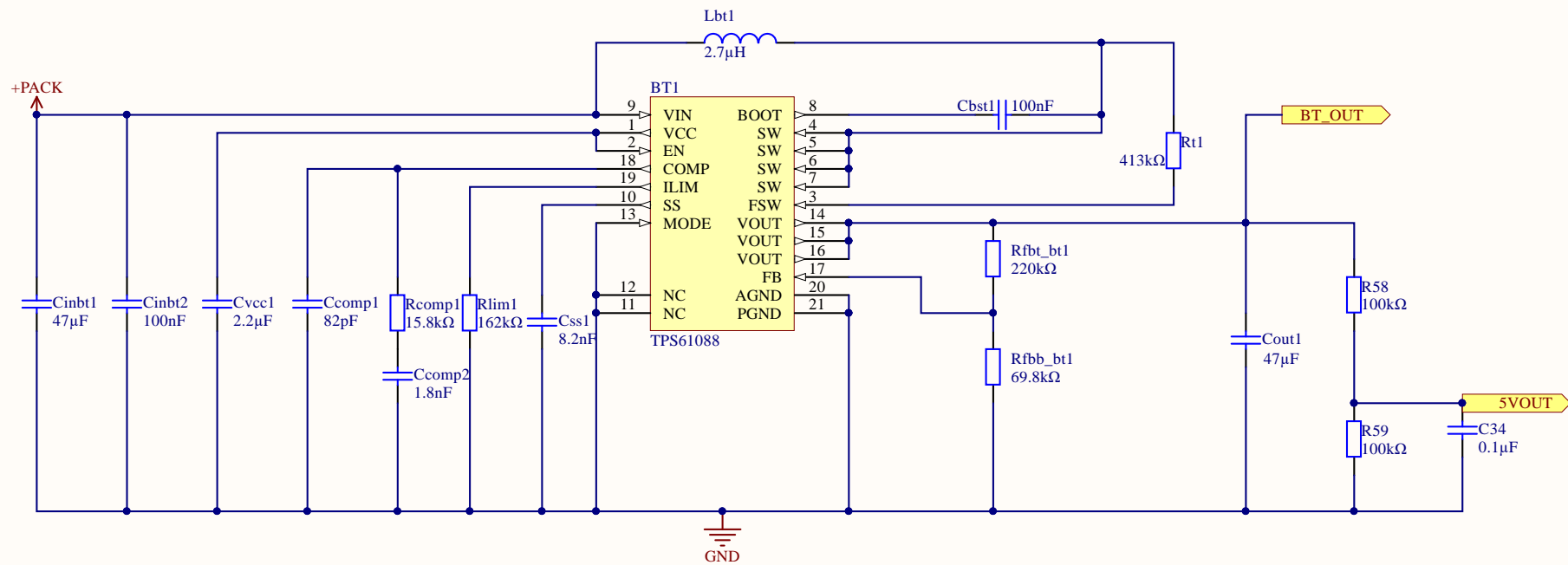


Title		
Size	Number	Revision
A4		
Date:	2018-12-05	Sheet of
File:	C:\Users\...\eps_pv.SchDoc	Drawn By:

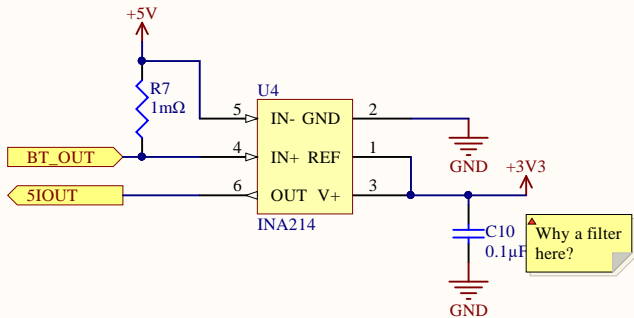
High current paths: negative terminal path from battery to GND, positive terminal through sense resistor to pack



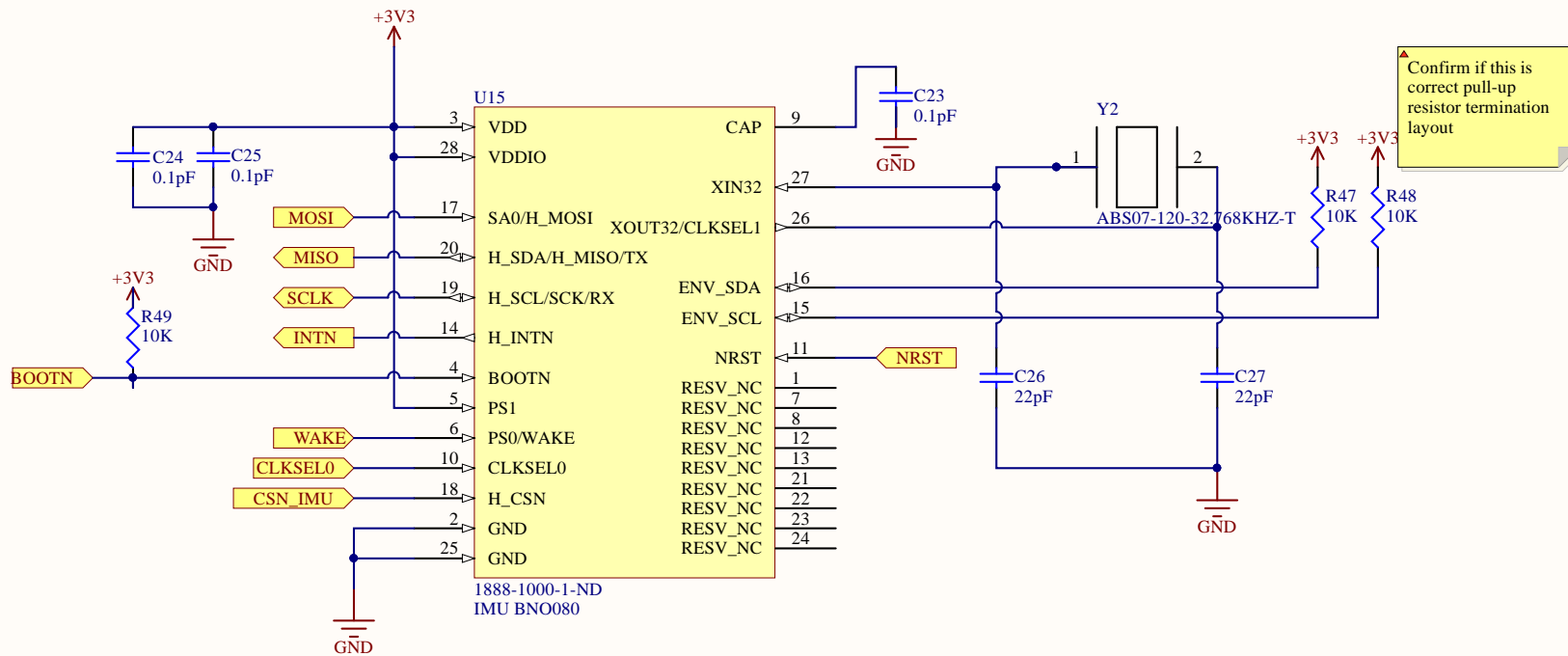
Title		
Size	Number	Revision
A4		
Date:	2018-12-05	Sheet of
File:	C:\Users\...\eps_batt.SchDoc	Drawn By:



Title			
Size	Number		Revision
A			
Date:	2018-12-05	Sheet	of
File:	C:\Users\...\eps_bt.SchDoc	Drawn By:	



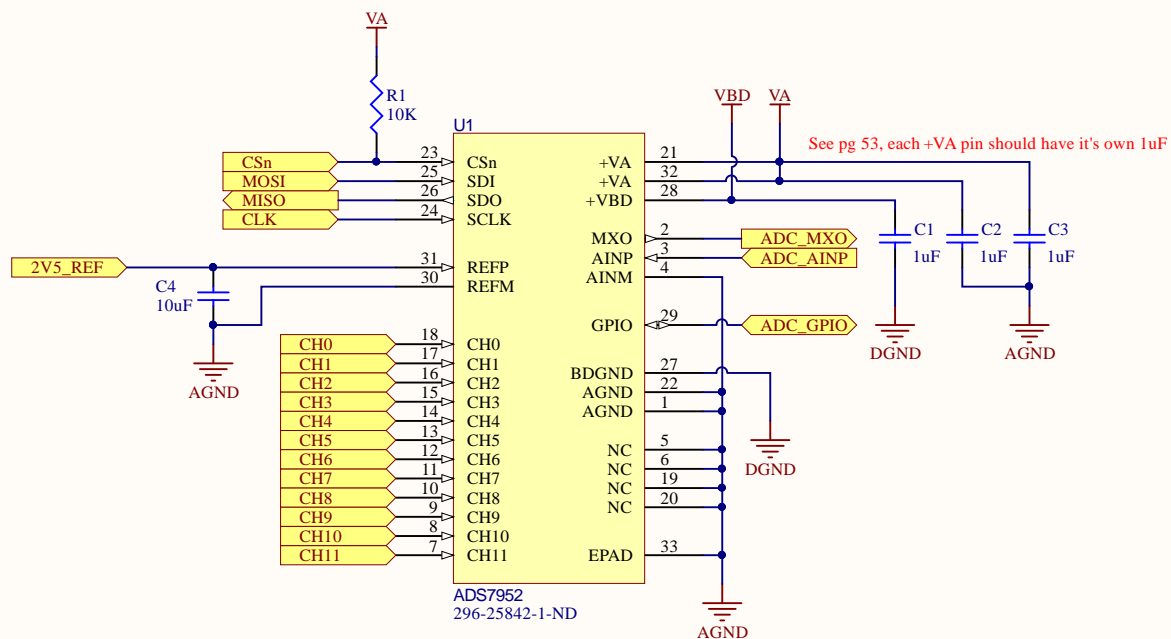
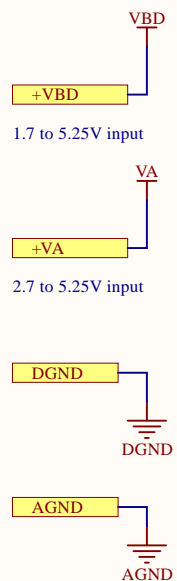
Title			
Size	Number		Revision
A4			
Date:	2018-12-05	Sheet	of
File:	C:\Users\...\bt_current_monitor.SchDoc	Drawn By:	



Title		
Size A	Number	Revision
Date:	2018-12-05	Sheet of
File:	C:\Users\...\eps_imu.SchDoc	Drawn By:

POWER INPUTS

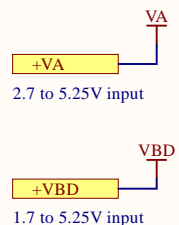
WARNING! +VA >= +VBD (pg 51)



Title		UTAT SS	
ADS7952		Revision	
Size	Number	1.0	
A4	*	of *	
Date:	2018-12-05	Sheet	*
File:	C:\Users\...\adc-ADS7952.SchDoc	Drawn By:	Dylan Vogel

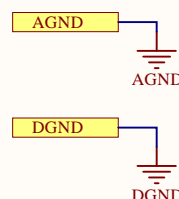
POWER PORTS

WARNING! +VA >= +VBD (pg 51)



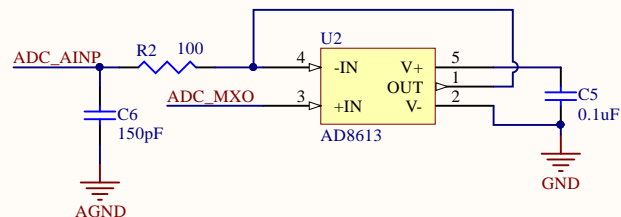
2V5 REF

WARNING: cannot source > 10mA



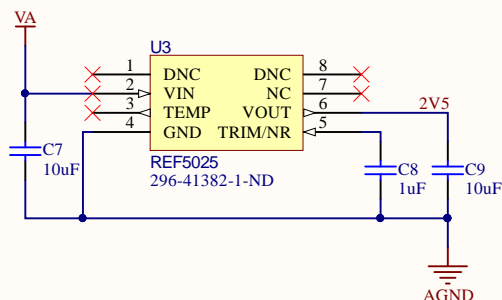
ADC INPUT BUFFER

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

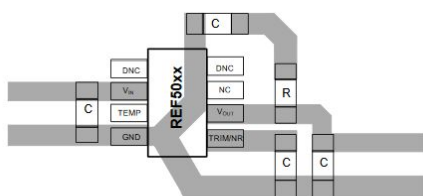
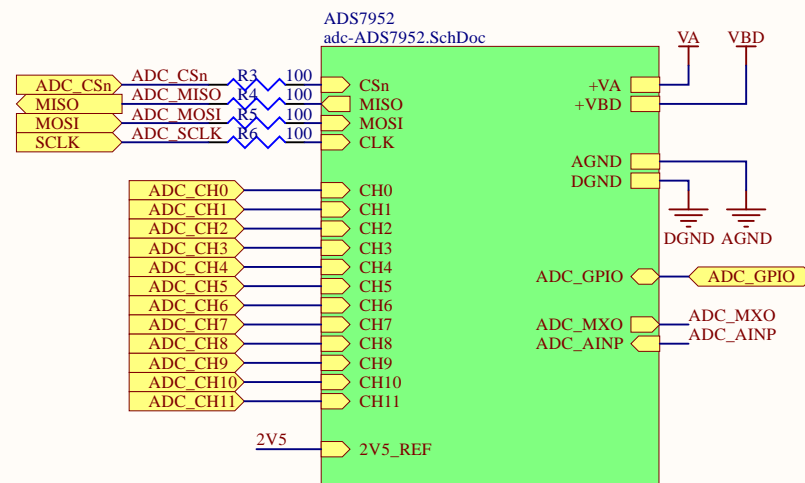


Figure 44. Layout Example

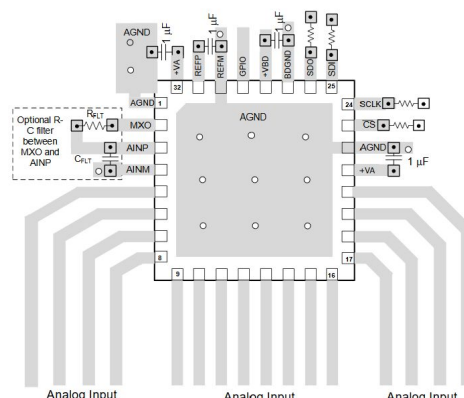


Figure 70. Recommended Layout for the VQFN Packaged Device

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 < 100 ohm. 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, +VA and +VBD 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		UTAT SS	
ADS7952 Circuit		Revision	
Size	Number	1.0	
A4	*		
Date:	2018-12-05	Sheet *	of *
File:	C:\Users\...\adc-circuit-ADS7952.SchDoc	Drawn By:	Dylan Vogel

POWER INPUT

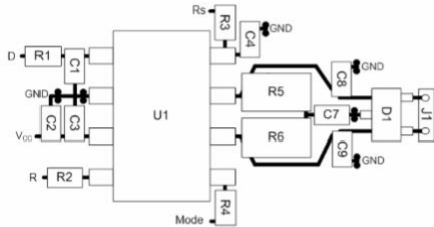
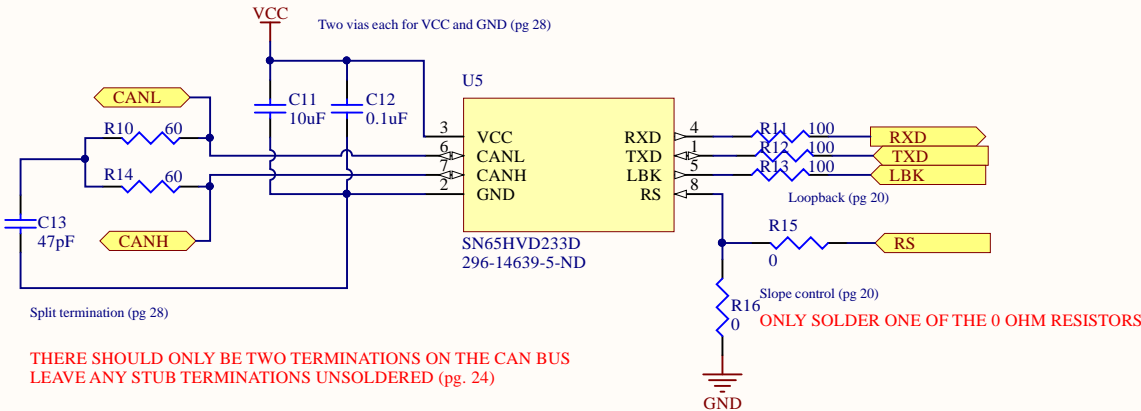
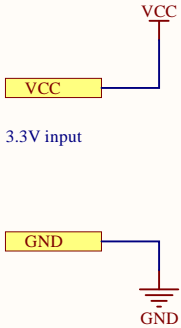


Figure 41. Layout Example Schematic

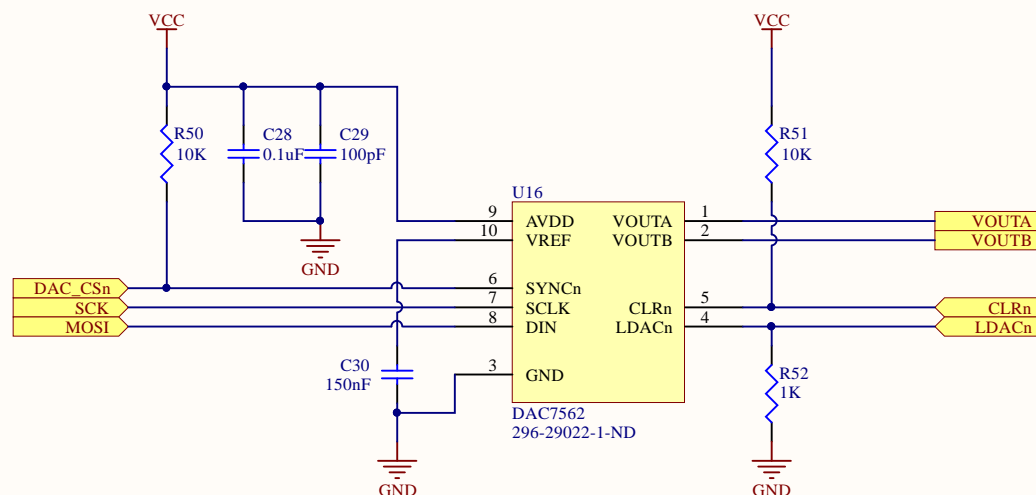
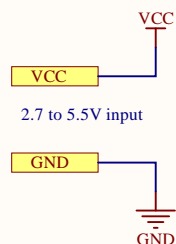
See pg. 28 of the datasheet for layout guidelines

This schematic implements the SN65HVD233 CAN transceiver 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 uController. Connecting the RS pin to a uController allows the device to be put into low-power mode by setting a voltage 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 transceivers on the bus should have 120 ohm terminations. Other devices should be placed on 'stub' networks where the terminations are left unsoldered

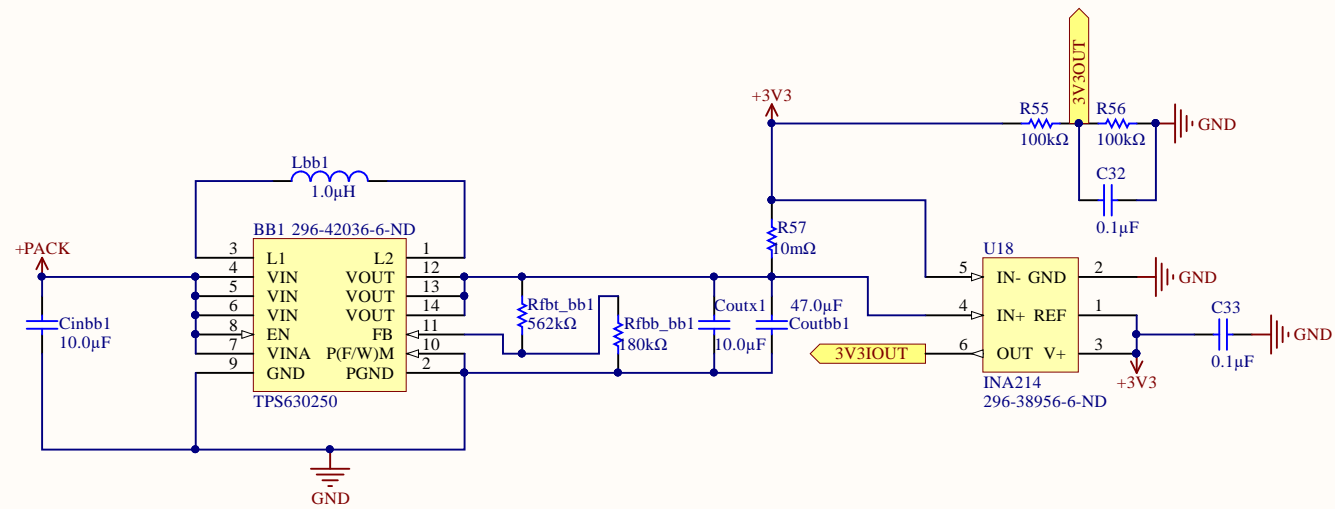
Title		UTAT SS	
SN65HVD233			
Size	Number	Revision	
A4	*	1.0	
Date:	2018-12-05	Sheet *	of *
File:	C:\Users\...\can-SN65HVD233.SchDoc	Drawn By:	Dylan Vogel



This schematic implements the DAC7562 16-bit digital-to-analog converter. The device has two configurable outputs, VOUTA and VOUTB, which can be digitally written through the 3-wire SPI interface. This particular device is set to zero scale (0V) both outputs upon power-on/reset. Toggling CLRN to LOW via an external GPIO will also zero both outputs.

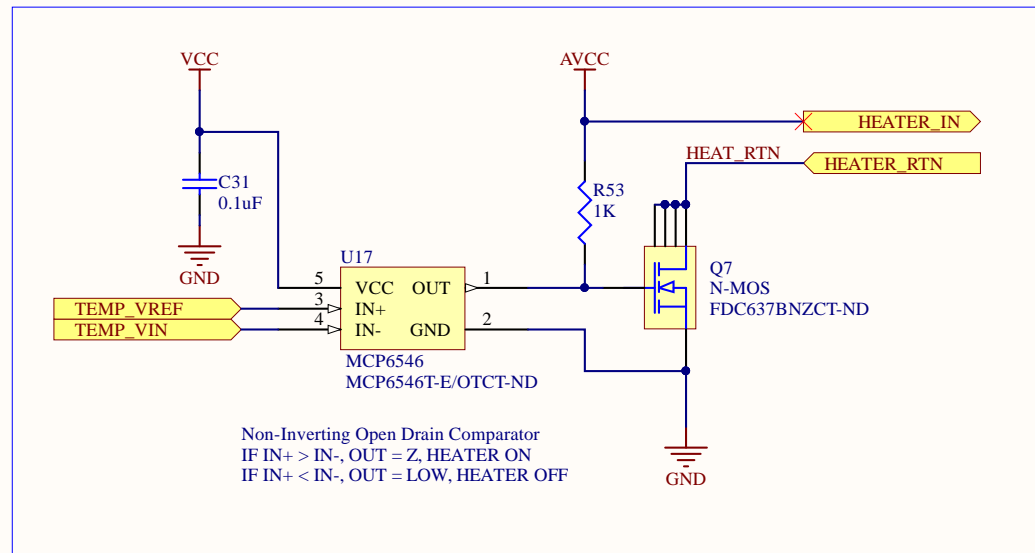
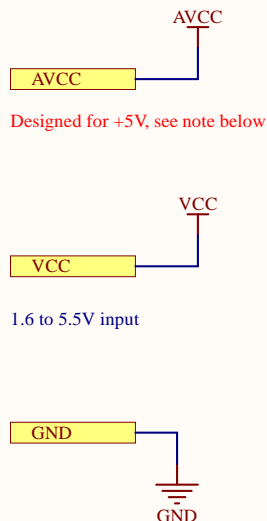
The device is connected in synchronous mode, where LDACn is connected to GND through a strong pull-down. This means that output VOUTA/VOUTB will be updated at the end of the SPI communication frame. The alternative would be to connect LDACn to a microcontroller GPIO and toggle it low manually to set all outputs at the same time. This is referred to as asynchronous mode in the datasheet.

Title DAC7562			UTAT SS		
Size A4	Number *			Revision 1.1	
Date:	2018-12-05			Sheet	* of *
File:	C:\Users\...\dac-DAC7562.SchDoc			Drawn By:	Dylan Vogel



Title		
Size	Number	Revision
A4		
Date:	2018-12-05	Sheet of
File:	C:\Users\...\eps_bb.SchDoc	Drawn By:

POWER INPUTS



LED HEATER STATUS INDICATION



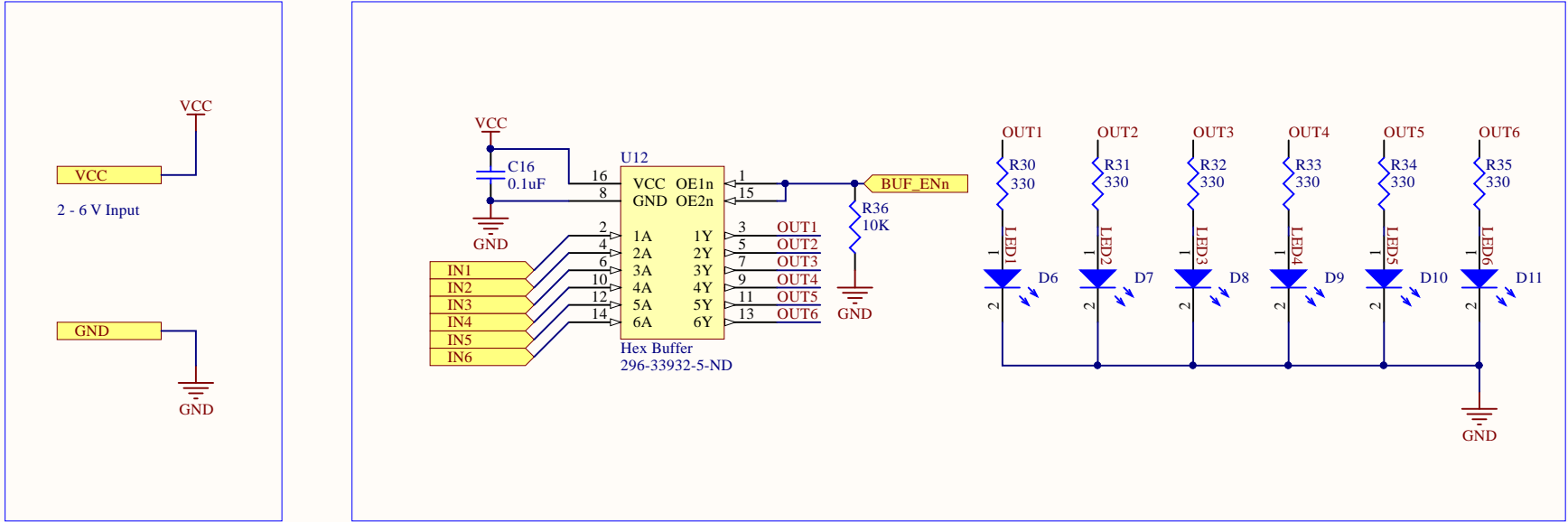
This schematic implements a single heater control circuit, relying on an open-drain comparator and NMOS switch for completely analog operation.

The temperature setpoint is set via the voltage on the TEMP_VREF pin, which is compared against the voltage on the TEMP_VIN pin. If the voltage on TEMP_VREF is higher, the output of the comparator will go high-impedance and drive the gate of the NMOS to 5V through the 1K pull-up resistor. This should be enough to switch the MOSFET in triode with a relatively low VDS at our target current (128mA).

Conversely, when TEMP_VIN is above TEMP_VREF, the output is switched to GND and the MOSFET turns off. How you decide to set TEMP_VREF and TEMP_VIN is entirely up to you.

The circuit is designed to work at 5V. To operate at different voltages, just be sure to check the relevant ratings on the different components.

Title		
Heater Control		
Size	Number	Revision
A	*	1
Date:	2018-12-05	Sheet * of *
File:	C:\Users\...\heater-control.SchDoc	Drawn By: B. Almeida, D. Vogel

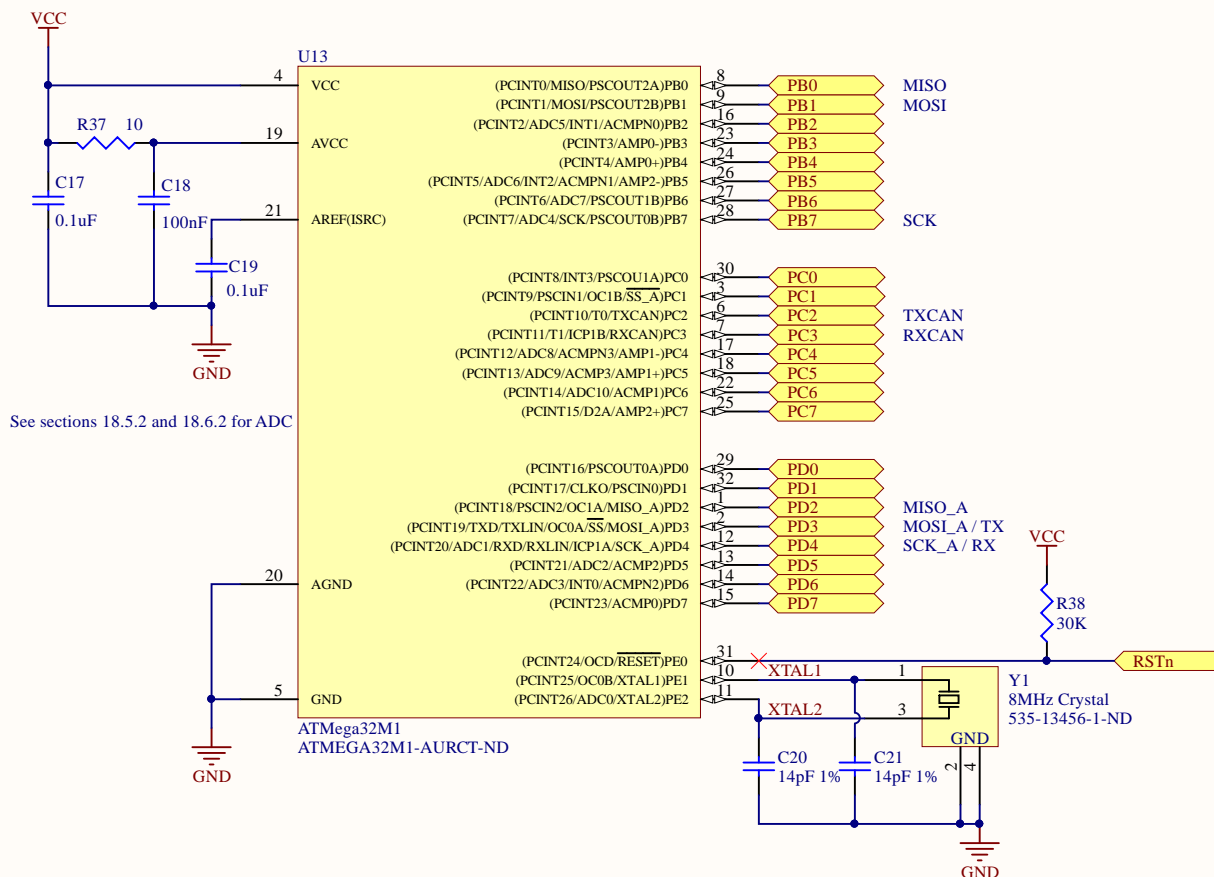
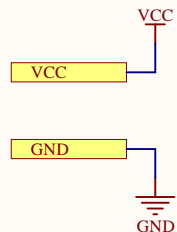


This schematic implements the SN74HC365PW non-inverting, tri-state hex buffer as an LED monitoring circuit. Connecting a signal to IN[1:6] will light up the corresponding LED on OUT[1:6].

- The BUF_ENn input can be connected to a microcontroller 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		UTAT SS	
SN74HC365PW LED Monitoring		Revision	
Size	Number	1.0	
A4	*		
Date:	2018-12-05	Sheet	of
File:	C:\Users\...\led-monitoring-SN74HC365PW.sch	1	1
Drawn By:		Dylan Vogel	

POWER INPUT



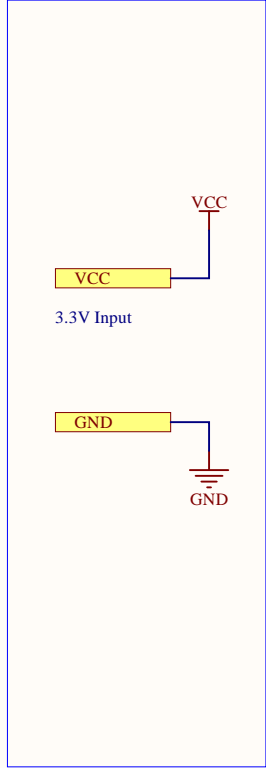
See sections 18.5.2 and 18.6.2 for ADC

This schematic implements the ATmega32M1 microcontroller with a 8 MHz external crystal and necessary power connections.

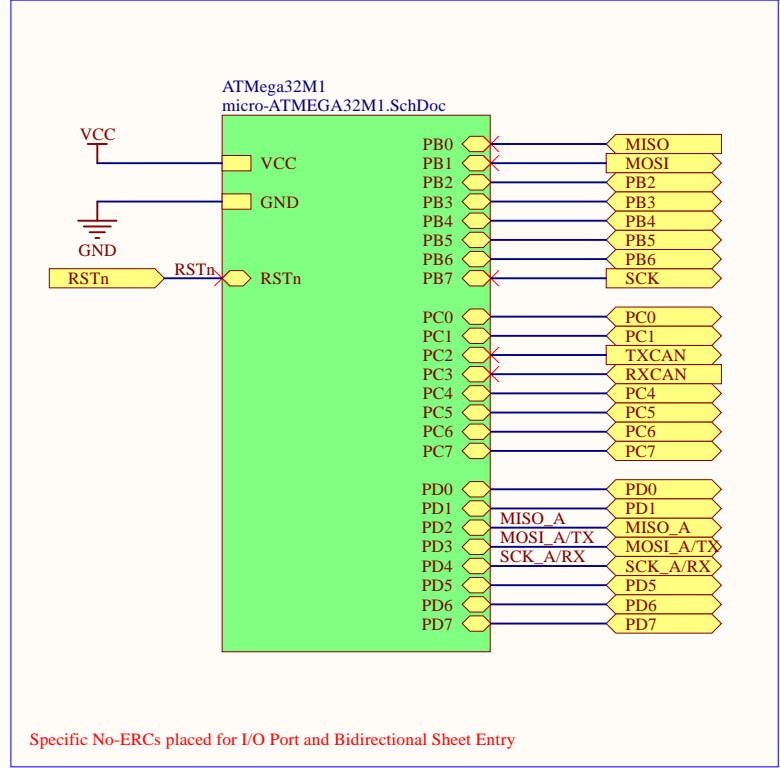
- Crystal is connected in a Pierce configuration, values of the capacitors were calculated based on the capacitance of the crystal and ESR.
- I would read through 18.5.2 and 18.6.2 of the complete 32M1 datasheet if you're interested in the motivation behind the ADC input connections. They recommend connecting 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 selected in software as the reference voltage.

Title		UTAT SS	
ATmega32M1			
Size	Number	Revision	
A4	*	1.0	
Date:	2018-12-05	Sheet *	of *
File:	C:\Users\...\micro-ATMEGA32M1.SchDoc	Drawn By: Dylan Vogel	

POWER INPUTS

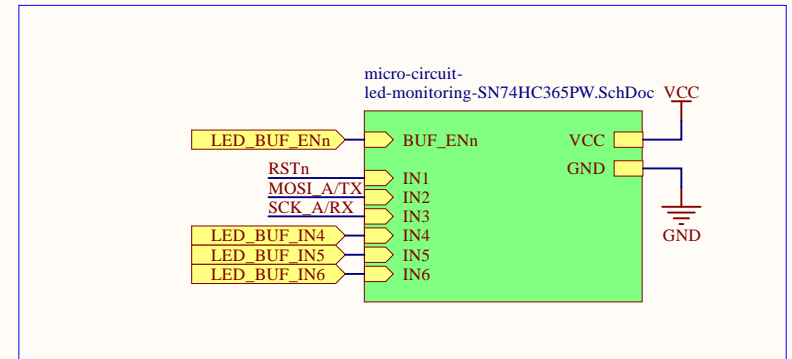
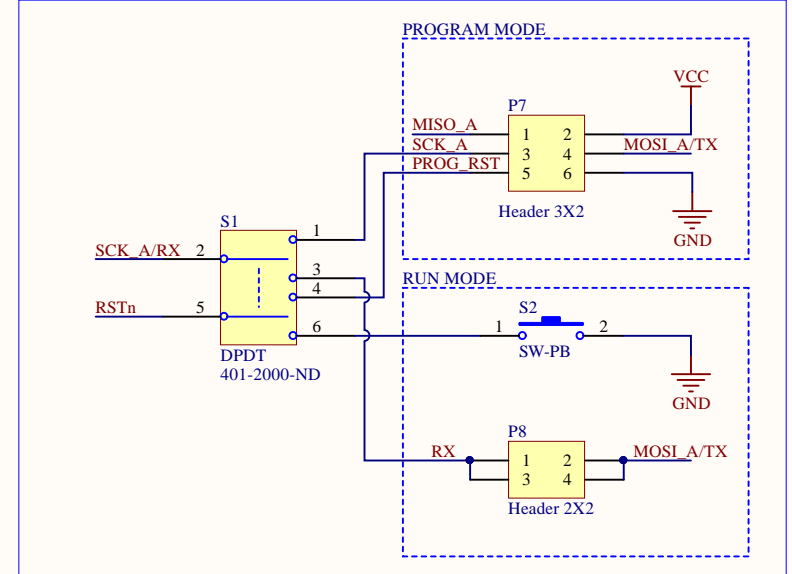


ATMEGA32M1



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

MODE SELECT CIRCUITRY

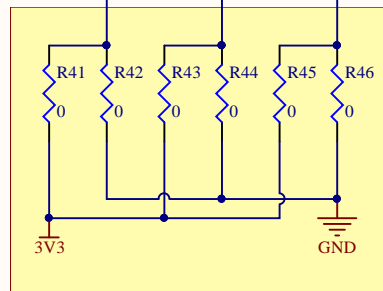
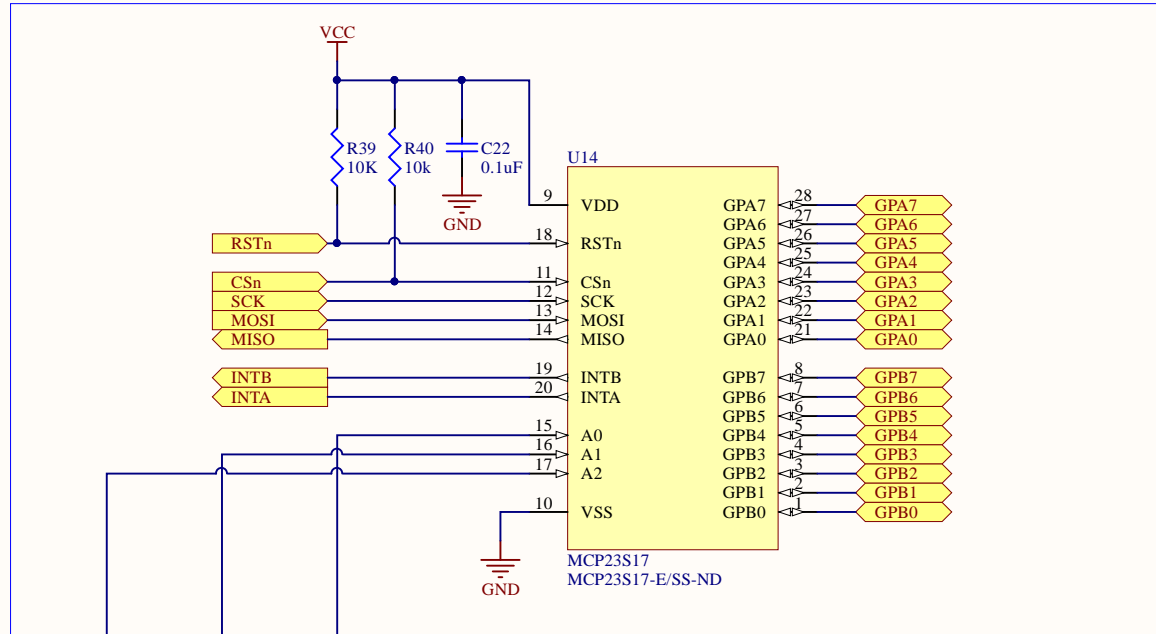
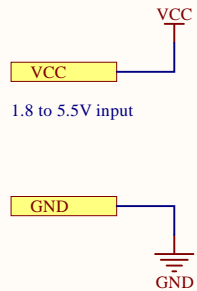


This schematic extends the functionality already included in the micro-ATMEGA32M1 schematic, adding a mode select switch, programming header, reset button and LED indication for TX, RX and RSTn.

- 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		UTAT SS	
ATMega32M1 Circuit			
Size	Number	Revision	
A4	*	1.0	
Date:	2018-12-05	Sheet	* of *
File:	C:\Users\...\micro-circuit-ATMEGA32M1	SchDoc By:	Dylan Vogel

POWER INPUTS



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 RSTn and CSn.

Multiple port expanders can be connected to the same CSn 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		UTAT SS	
MCP23S17		Revision	
Size	Number	1.0	
A4	*		
Date:	2018-12-05	Sheet	* of *
File:	C:\Users\...\pex-MCP23S17.SchDoc	Drawn By:	Dylan Vogel

