Power

File: power.kicad_sch

Micocontroller

File: microcontroller.kicad_sch

Base_Sensor

+V5.0   ENABLE/*SHDN

GND_CB
                                              SPI_MISO
                                              SPI_MOSI
                                              SPI_SCLK
                                               SPI_CS0

                                               I2C_SDA
                                               I2C_SCL

File: sensor_base.kicad_sch
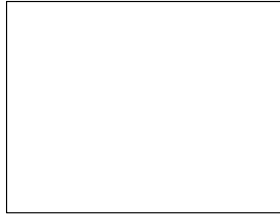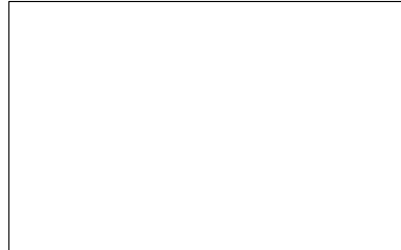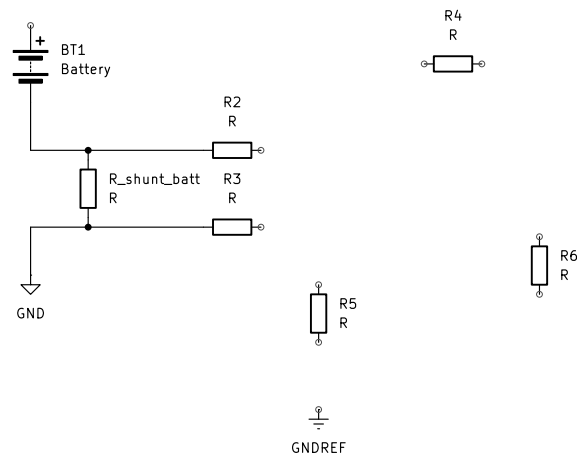
Sensor Module

File: sensor_module.kicad_sch

General Design requirements:
— Power switching (need to be able to reduce power consumption
  as much as possible). Everything that draws power must be able
  to be switched off or must have a shutdown pin.
— Low noise interfaces on sensor inputs.
— High frequency lines should be adequately blocked

The 5V power rail is supplied by a battery bank. We need to have some more
power conditioning in order to make sure that we aren't coupling
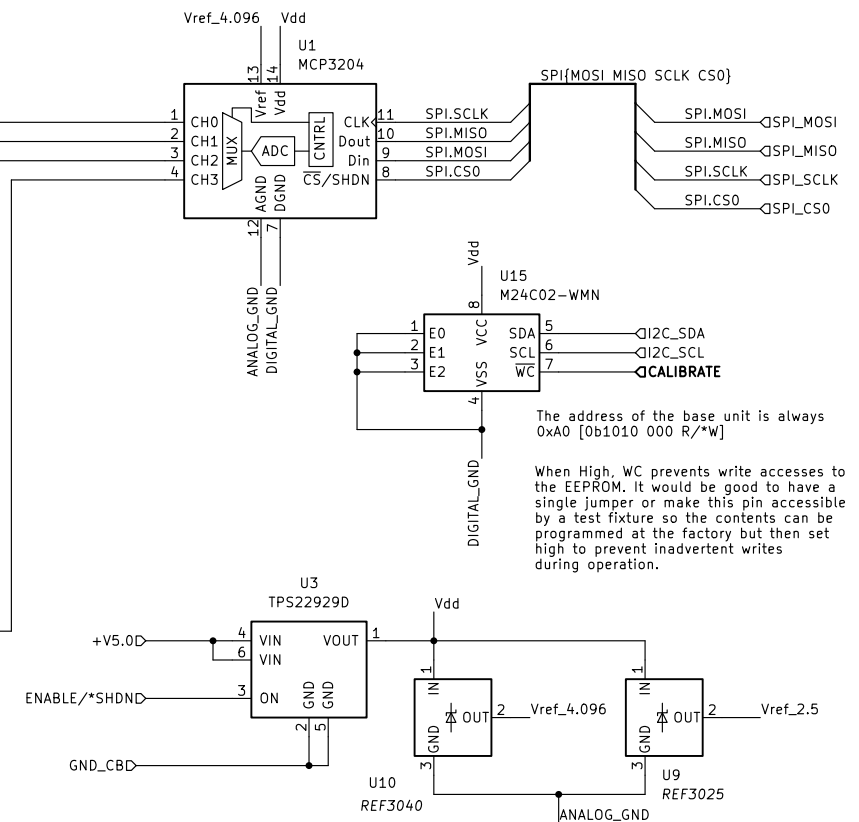too much noise into the ADC circuits. To this end, we may want to use an
LDO to provide a lower voltage rail to the OP-amp circuits, or use a
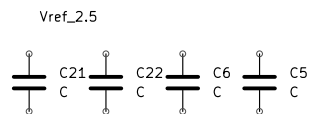higher voltage battery and use the LDO to provide a "clean" 5.0V rail.

BT1
Battery

R4
R

R2
R

R_shunt_batt
R

R3
R

GND

R6
R

R5
R

GNDREF

Battery Sense

INA333xxDGK
U11

BATTERY_SENSE_+
BATTERY_SENSE_−

R13
R

R7
R

C2
C

Vdd
Vref_2.5
ANALOG_GND

Ext Temperature Sense

J2
Conn_Coaxial

INA333xxDGK
U2

R9
R

R8
R

C3
C

Vdd
Vref_2.5
ANALOG_GND

Leak Detector

U4
INA333xxDGK

R10
R

R12
R

C4
C

Vdd
Vref_2.5
ANALOG_GND

U5
INA333xxDGK

R11
R

R1
R

C1
C

Vdd
Vref_2.5
ANALOG_GND
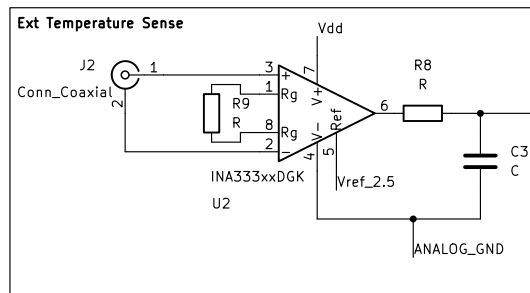
All Gains of INA333 are set by:
$G = 1 + (100\ k\Omega\ /\ RG)$.
(RG is Gain Resistor between pins 1 & 8)

MCP3204

Vref_4.096   Vdd
U1
MCP3204

CH0
CH1
CH2
CH3

MUX   ADC   CNTRL

Vref Vdd
CLK
Dout
Din
$\overline{CS}$/SHDN

AGND DGND

ANALOG_GND
DIGITAL_GND

SPI.SCLK
SPI.MISO
SPI.MOSI
SPI.CS0

SPI{MOSI MISO SCLK CS0}

SPI.MOSI
SPI.MISO
SPI.SCLK
SPI.CS0

SPI_MOSI
SPI_MISO
SPI_SCLK
SPI_CS0

U15
M24C02−WMN

E0
E1
E2

VCC
VSS

SDA
SCL
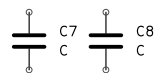$\overline{WC}$

I2C_SDA
I2C_SCL
CALIBRATE

Vdd
DIGITAL_GND
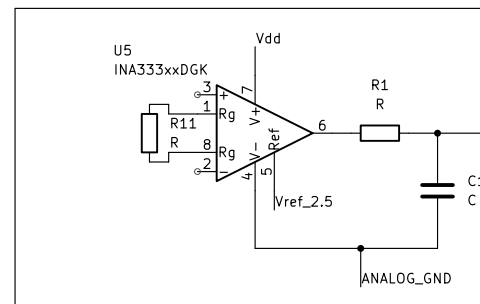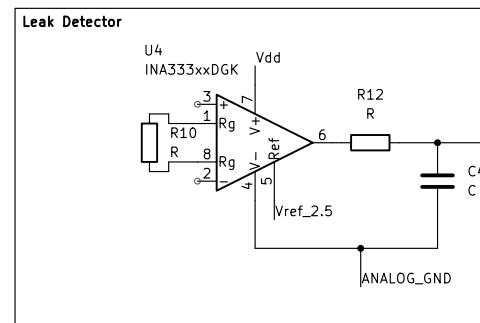
The address of the base unit is always
0xA0 [0b1010 000 R/*W]

When High, WC prevents write accesses to
the EEPROM. It would be good to have a
single jumper or make this pin accessible
by a test fixture so the contents can be
programmed at the factory but then set
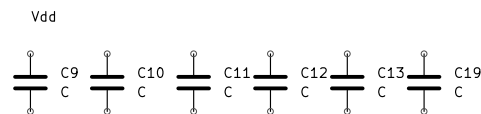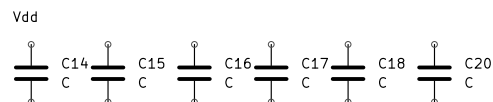high to prevent inadvertent writes
during operation.

U3 TPS22929D

+V5.0
ENABLE/*SHDN
GND_CB

VIN
VIN
ON
GND
GND

VOUT

U3
TPS22929D

Vdd

IN
GND
OUT

U10
REF3040

Vref_4.096

IN
GND
OUT

U9
REF3025

Vref_2.5

ANALOG_GND

TL431 might also be used for the 2.5V reference but
buffered with an OPA333 or equivalent.

R14
0 Ohm
DIGITAL_GND ———— ANALOG_GND

Base Sensor Circuit
This sensor board is included in the base unit. It includes built−in
temperature probe, battery Coulomb counting, leak detector, and TBD.

Reference Decoupling

Vref_2.5

C21 C22 C6   C5
C   C   C   C

Vref_4.096

C7   C8
C   C

Analog Decoupling

Vdd

C9   C10 C11 C12 C13 C19
C   C   C   C   C   C

ANALOG_GND

Digital Decoupling

Vdd

C14 C15 C16 C17 C18 C20
C   C   C   C   C   C

DIGITAL_GND

Base Sensor Circuit
This sensor board is included in the base unit. It includes built-in
temperature probe, battery Coulomb counting, and up to 6 expansion
circuits. We may DNP some of these depending on the particular model.

U13
MCP3208

CH0	
CH1	
CH2	
CH3	MUX
CH4	
CH5	
CH6	
CH7	

ADC CNTRL

CLK   13 SPI.SCLK
Dout 12 SPI.MISO
Din   11 SPI.MOSI
CS/SHDN 10 SPI.CS0

SPI{MOSI MISO SCLK CS0}

SPI.MOSI   SPI_MOSI
SPI.MISO   SPI_MISO
SPI.SCLK   SPI_SCLK
SPI.CS0   SPI_CS0

U6
M24C02-WMN

SLOT_1_ADDR_0   1 E0   SDA 5   I2C_SDA
SLOT_1_ADDR_1   2 E1 VCC   SCL 6   I2C_SCL
SLOT_1_ADDR_2   3 E2   WC   7
                    VSS

U14
INA333xxDGK

Rg
V+
V-
Ref

U7
TPS22929D

+V5.0   4 VIN
         6 VIN   VOUT 1
ENABLE/*SHDN 3 ON
                  GND GND
GND_CB   2   5

U8
REF3040

IN 1
OUT 2 Vref_4.096
GND 3

U12
REF3025

IN 1
OUT 2 Vref_2.5
GND 3

ANALOG_GND