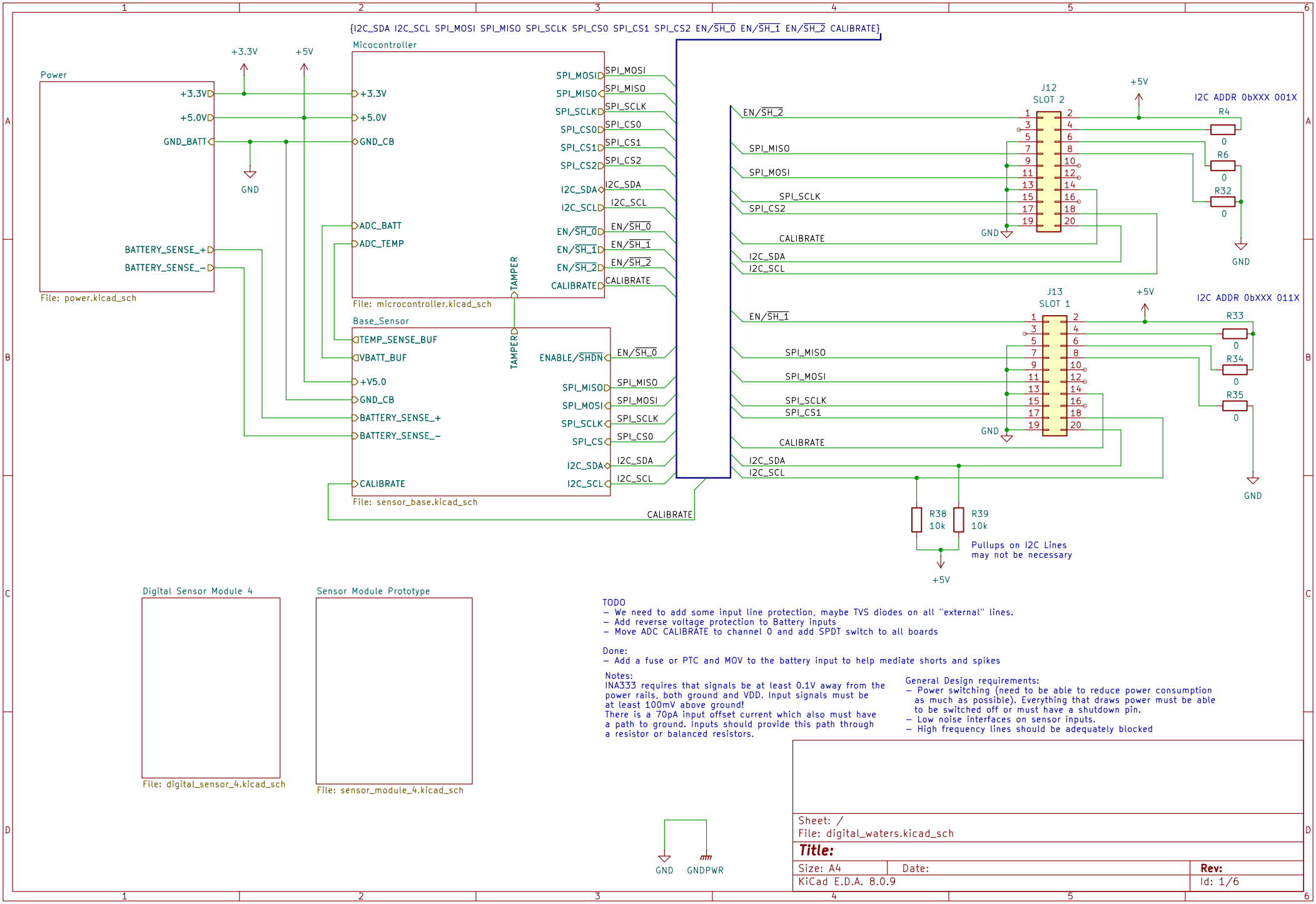
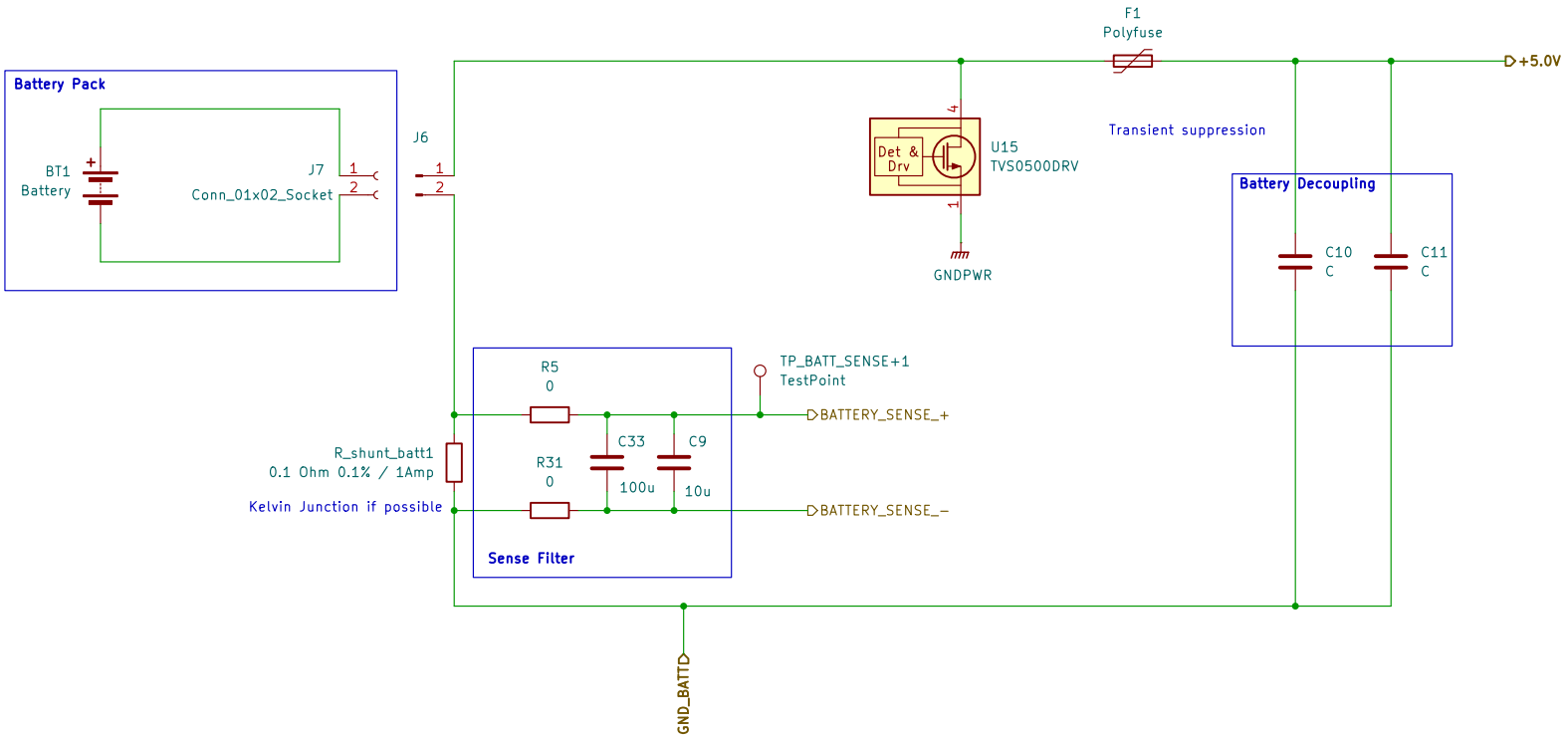
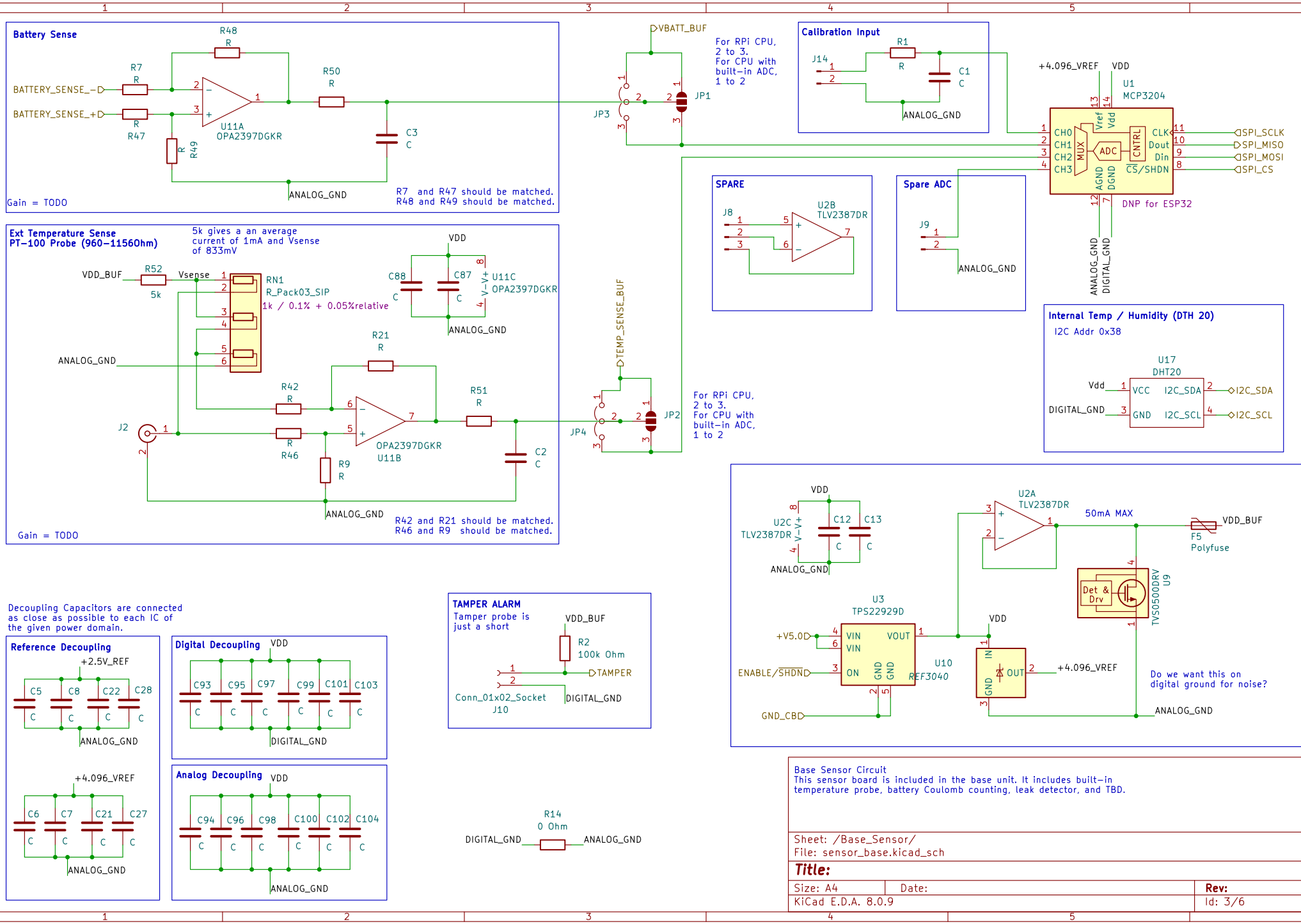
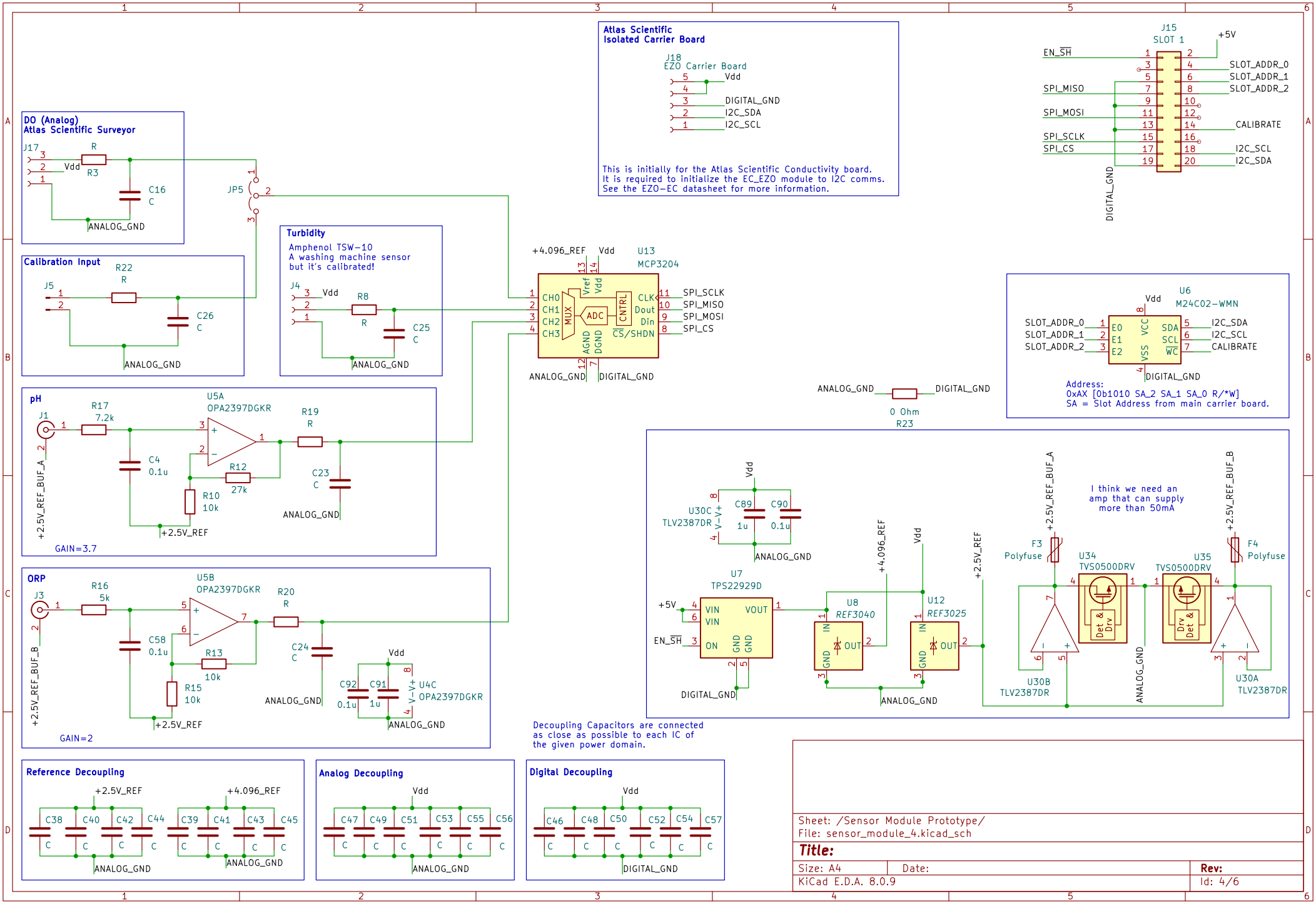

{I2C_SDA I2C_SCL SPI_MOSI SPI_MISO SPI_SCLK SPI_CS0 SPI_CS1 SPI_CS2 EN/SH_0 EN/SH_1 EN/SH_2 CALIBRATE}
Power
+3.3V
+5.0V
GND_BATT
GND
BATTERY_SENSE_+
BATTERY_SENSE_−
File: power.kicad_sch
Micocontroller
+3.3V
+5.0V
GND_CB
ADC_BATT
ADC_TEMP
TAMPER
SPI_MOSI
SPI_MISO
SPI_SCLK
SPI_CS0
SPI_CS1
SPI_CS2
I2C_SDA
I2C_SCL
EN/SH_0
EN/SH_1
EN/SH_2
CALIBRATE
File: microcontroller.kicad_sch
Base_Sensor
TEMP_SENSE_BUF
VBATT_BUF
+V5.0
GND_CB
BATTERY_SENSE_+
BATTERY_SENSE_−
CALIBRATE
TAMPER
ENABLE/SHDN
EN/SH_0
SPI_MISO
SPI_MOSI
SPI_SCLK
SPI_CS0
I2C_SDA
I2C_SCL
File: sensor_base.kicad_sch
J12
SLOT 2
J13
SLOT 1
+5V
GND
I2C ADDR 0bXXX 001X
I2C ADDR 0bXXX 011X
R4
R6
R32
R33
R34
R35
0
R38
10k
R39
10k
Pullups on I2C Lines
may not be necessary
Digital Sensor Module 4
File: digital_sensor_4.kicad_sch
Sensor Module Prototype
File: sensor_module_4.kicad_sch
TODO
– We need to add some input line protection, maybe TVS diodes on all "external" lines.
– Add reverse voltage protection to Battery inputs
– Move ADC CALIBRATE to channel 0 and add SPDT switch to all boards
Done:
– Add a fuse or PTC and MOV to the battery input to help mediate shorts and spikes
Notes:
INA333 requires that signals be at least 0.1V away from the power rails, both ground and VDD. Input signals must be at least 100mV above ground!
There is a 70pA input offset current which also must have a path to ground. Inputs should provide this path through a resistor or balanced resistors.
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
GND
GNDPWR
Sheet: /
File: digital_waters.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. 8.0.9
Id: 1/6



Sheet: /Power/		
File: power.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
KiCad E.D.A. 8.0.9		Id: 2/6


Battery Sense
R48
R
R7
R
BATTERY_SENSE_-
BATTERY_SENSE_+
R
R47
U11A
OPA2397DGKR
R50
R
C3
C
R
R49
ANALOG_GND
Gain = TODO
R7 and R47 should be matched.
R48 and R49 should be matched.
VBATT_BUF
For RPi CPU,
2 to 3.
For CPU with
built-in ADC,
1 to 2
JP3
JP1
Calibration Input
J14
R1
R
C1
C
ANALOG_GND
+4.096_VREF
VDD
U1
MCP3204
Vref
Vdd
CH0
CH1
CH2
CH3
MUX
ADC
CNTRL
CLK
Dout
Din
CS/SHDN
AGND
DGND
SPI_SCLK
SPI_MISO
SPI_MOSI
SPI_CS
DNP for ESP32
ANALOG_GND
DIGITAL_GND
SPARE
J8
U2B
TLV2387DR
Spare ADC
J9
ANALOG_GND
Ext Temperature Sense
PT-100 Probe (960-11560hm)
5k gives a an average
current of 1mA and Vsense
of 833mV
VDD_BUF
R52
5k
Vsense
RN1
R_Pack03_SIP
1k / 0.1% + 0.05%relative
C88
C87
C
U11C
OPA2397DGKR
ANALOG_GND
R21
R
R42
R
R51
R
J2
R
R46
R9
R
OPA2397DGKR
U11B
C2
C
TEMP_SENSE_BUF
JP4
JP2
For RPi CPU,
2 to 3.
For CPU with
built-in ADC,
1 to 2
ANALOG_GND
R42 and R21 should be matched.
R46 and R9 should be matched.
Gain = TODO
Internal Temp / Humidity (DTH 20)
I2C Addr 0x38
U17
DHT20
Vdd
VCC
I2C_SDA
GND
I2C_SCL
DIGITAL_GND
Decoupling Capacitors are connected
as close as possible to each IC of
the given power domain.
Reference Decoupling
+2.5V_REF
C5
C8
C22
C28
C
ANALOG_GND
+4.096_VREF
C6
C7
C21
C27
ANALOG_GND
Digital Decoupling
VDD
C93
C95
C97
C99
C101
C103
DIGITAL_GND
Analog Decoupling
VDD
C94
C96
C98
C100
C102
C104
ANALOG_GND
TAMPER ALARM
Tamper probe is
just a short
VDD_BUF
R2
100k Ohm
TAMPER
Conn_01x02_Socket
J10
DIGITAL_GND
R14
0 Ohm
DIGITAL_GND
ANALOG_GND
U2C
TLV2387DR
C12
C13
U2A
TLV2387DR
50mA MAX
VDD_BUF
F5
Polyfuse
Det &
Drv
TVS0500DRV
U9
U3
TPS22929D
+V5.0
ENABLE/SHDN
GND_CBD
VIN
VOUT
ON
GND
REF3040
U10
+4.096_VREF
Do we want this on
digital ground for noise?
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.
Sheet: /Base_Sensor/
File: sensor_base.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. 8.0.9
Id: 3/6


DO (Analog)
Atlas Scientific Surveyor
J17
R
R3
Vdd
C16
C
ANALOG_GND
JP5
Calibration Input
J5
R22
R
C26
C
ANALOG_GND
Turbidity
Amphenol TSW-10
A washing machine sensor
but it's calibrated!
J4
Vdd
R8
R
C25
C
ANALOG_GND
Atlas Scientific
Isolated Carrier Board
J18
EZO Carrier Board
Vdd
DIGITAL_GND
I2C_SDA
I2C_SCL
This is initially for the Atlas Scientific Conductivity board.
It is required to initialize the EC_EZO module to I2C comms.
See the EZO-EC datasheet for more information.
J15
SLOT 1
+5V
EN_SH
SLOT_ADDR_0
SLOT_ADDR_1
SLOT_ADDR_2
SPI_MISO
SPI_MOSI
CALIBRATE
SPI_SCLK
SPI_CS
I2C_SCL
I2C_SDA
DIGITAL_GND
+4.096_REF
Vdd
U13
MCP3204
CH0
CH1
CH2
CH3
MUX
ADC
Vref
Vdd
CNTRL
CLK
Dout
Din
CS/SHDN
AGND
DGND
SPI_SCLK
SPI_MISO
SPI_MOSI
SPI_CS
ANALOG_GND
DIGITAL_GND
ANALOG_GND
DIGITAL_GND
0 Ohm
R23
U6
M24C02-WMN
Vdd
SLOT_ADDR_0
SLOT_ADDR_1
SLOT_ADDR_2
E0
E1
E2
VCC
VSS
SDA
SCL
WC
I2C_SDA
I2C_SCL
CALIBRATE
DIGITAL_GND
Address:
0xAX [0b1010 SA_2 SA_1 SA_0 R/*W]
SA = Slot Address from main carrier board.
pH
J1
R17
7.2k
U5A
OPA2397DGKR
R19
R
C4
0.1u
R12
27k
R10
10k
C23
C
ANALOG_GND
+2.5V_REF_BUF_A
+2.5V_REF
GAIN=3.7
ORP
J3
R16
5k
U5B
OPA2397DGKR
R20
R
C58
0.1u
R13
10k
R15
10k
C24
C
ANALOG_GND
+2.5V_REF_BUF_B
+2.5V_REF
GAIN=2
U30C
TLV2387DR
Vdd
C89
1u
C90
0.1u
ANALOG_GND
U7
TPS22929D
+5V
EN_SH
VIN
VOUT
ON
GND
DIGITAL_GND
U8
REF3040
U12
REF3025
+4.096_REF
Vdd
+2.5V_REF
ANALOG_GND
I think we need an
amp that can supply
more than 50mA
+2.5V_REF_BUF_A
+2.5V_REF_BUF_B
F3
Polyfuse
F4
Polyfuse
U34
TVS0500DRV
U35
TVS0500DRV
Det &
Drv
U30B
TLV2387DR
U30A
TLV2387DR
ANALOG_GND
Decoupling Capacitors are connected
as close as possible to each IC of
the given power domain.
U4C
OPA2397DGKR
C92
0.1u
C91
1u
Reference Decoupling
+2.5V_REF
+4.096_REF
C38
C40
C42
C44
C39
C41
C43
C45
ANALOG_GND
Analog Decoupling
Vdd
C47
C49
C51
C53
C55
C56
ANALOG_GND
Digital Decoupling
Vdd
C46
C48
C50
C52
C54
C57
DIGITAL_GND
Sheet: /Sensor Module Prototype/
File: sensor_module_4.kicad_sch
Title:
Size: A4
Date:
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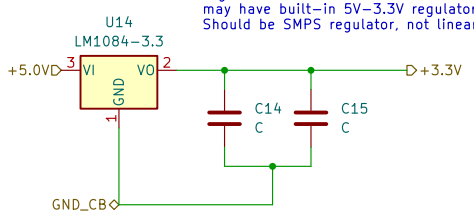
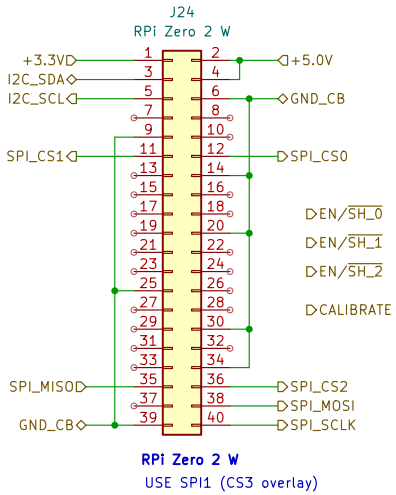
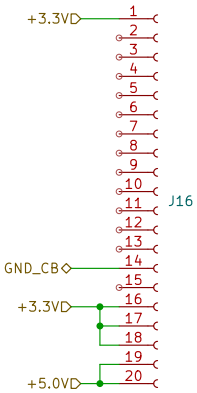
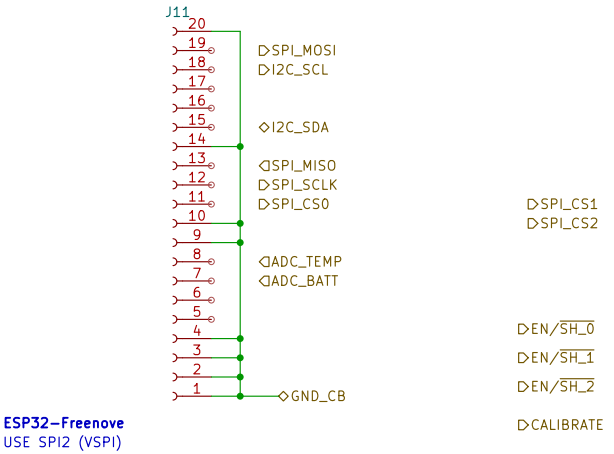
This is a placeholder for a CPU module.
Could be a Raspberry Pi or ESP32 or another microcontroller module with (TBD) GPIO lines, at least one SPI bus with (3) CS lines, and one I2C Bus.

Place-holder for a 3.3V supply.
Might not need this since the CPU modules may have built-in 5V-3.3V regulators.
Should be SMPS regulator, not linear.









TAMPER

TAMPER

Sheet: /Micocontroller/		
File: microcontroller.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
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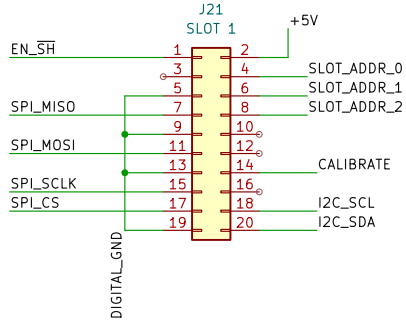
Some sensors will need to come with their own digital breakout boards (DO, CO2, EC, etc.) To support these, this board provides a common interface to the CPU and signal conditioning to those units.



Sheet: /Digital Sensor Module 4/ File: digital_sensor_4.kicad_sch		
Title:		
Size: A4	Date:	**Rev:**
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