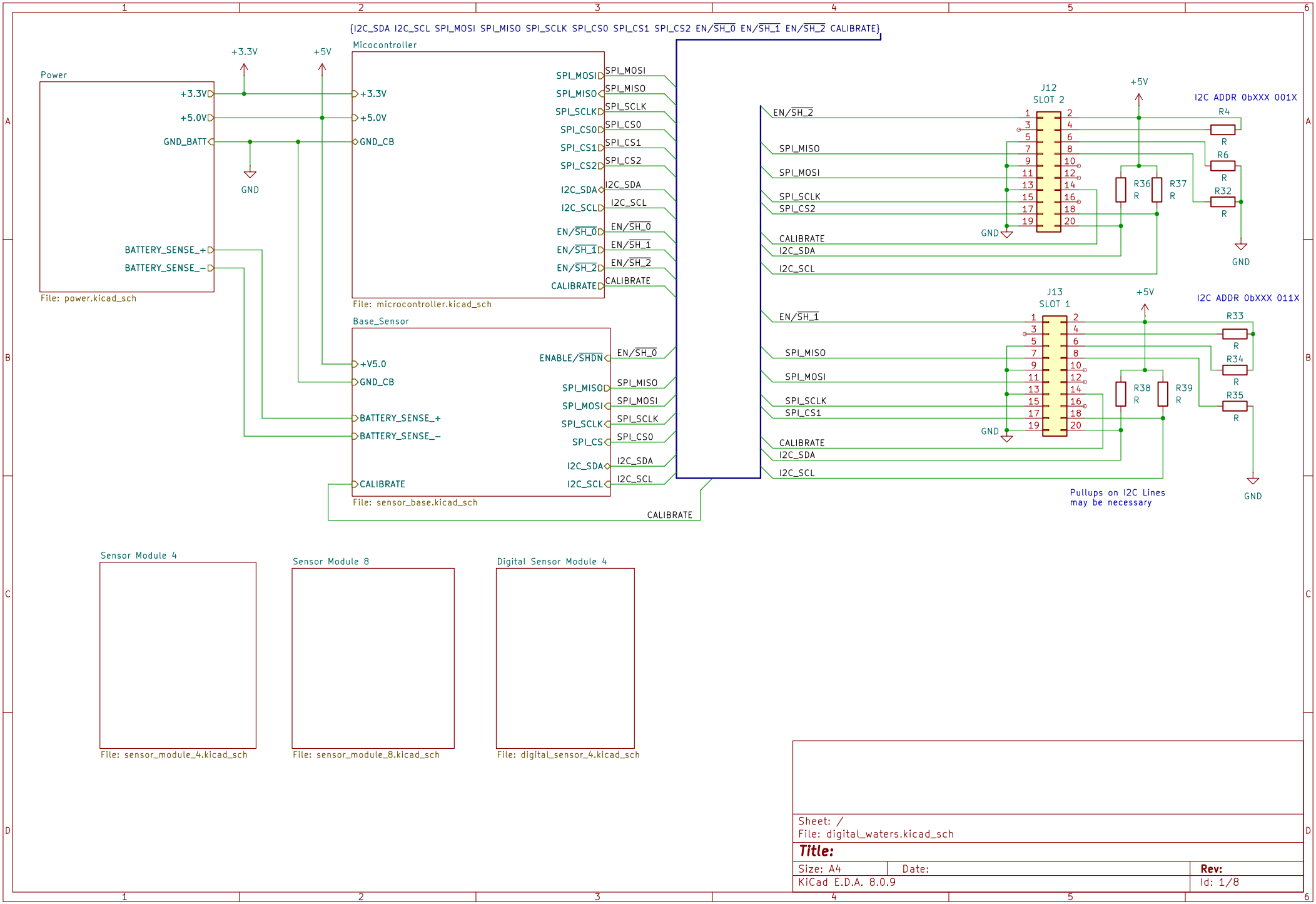
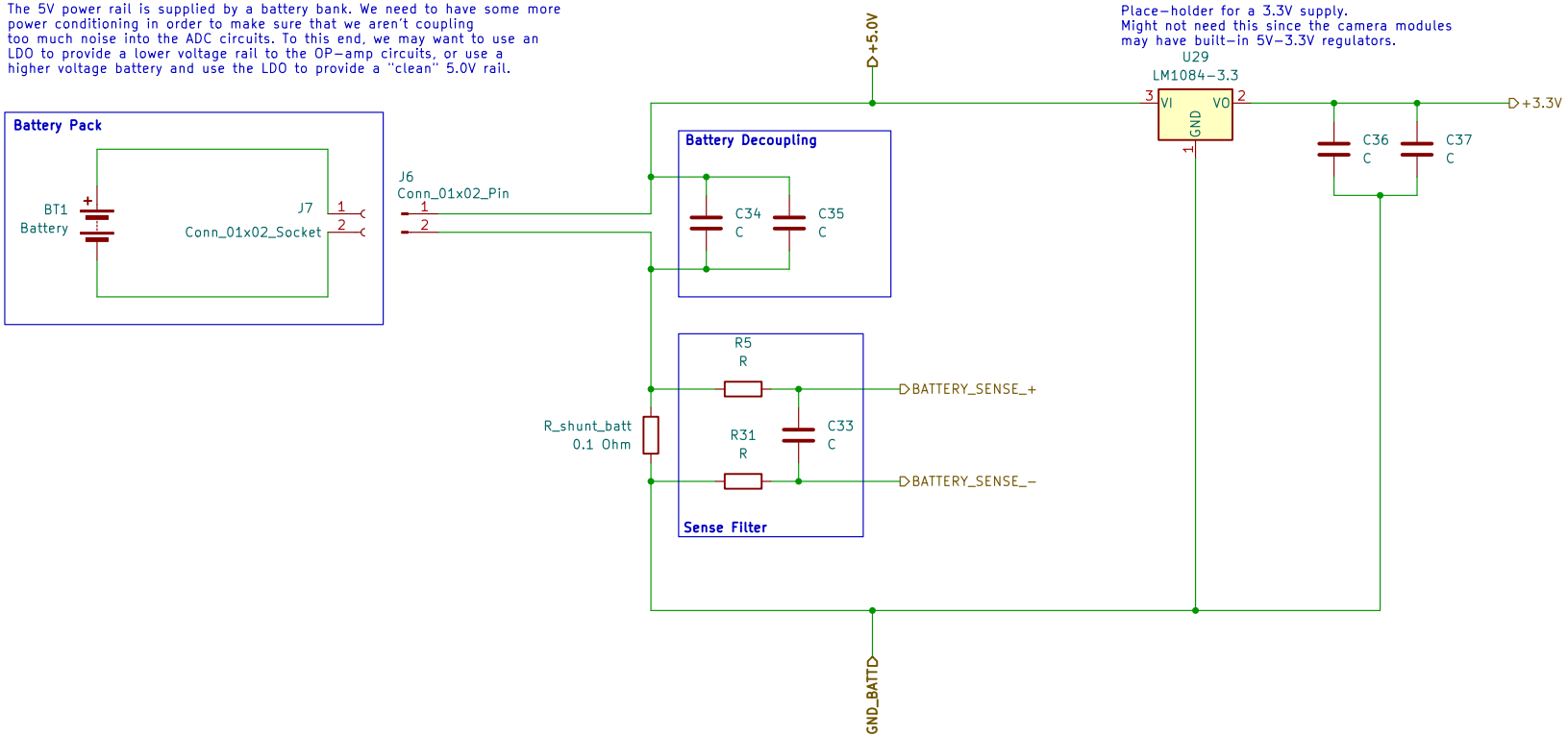
to be switched off or must have a shutdown pin.
– Low noise interfaces on sensor inputs.
– High frequency lines should be adequately blocked



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.

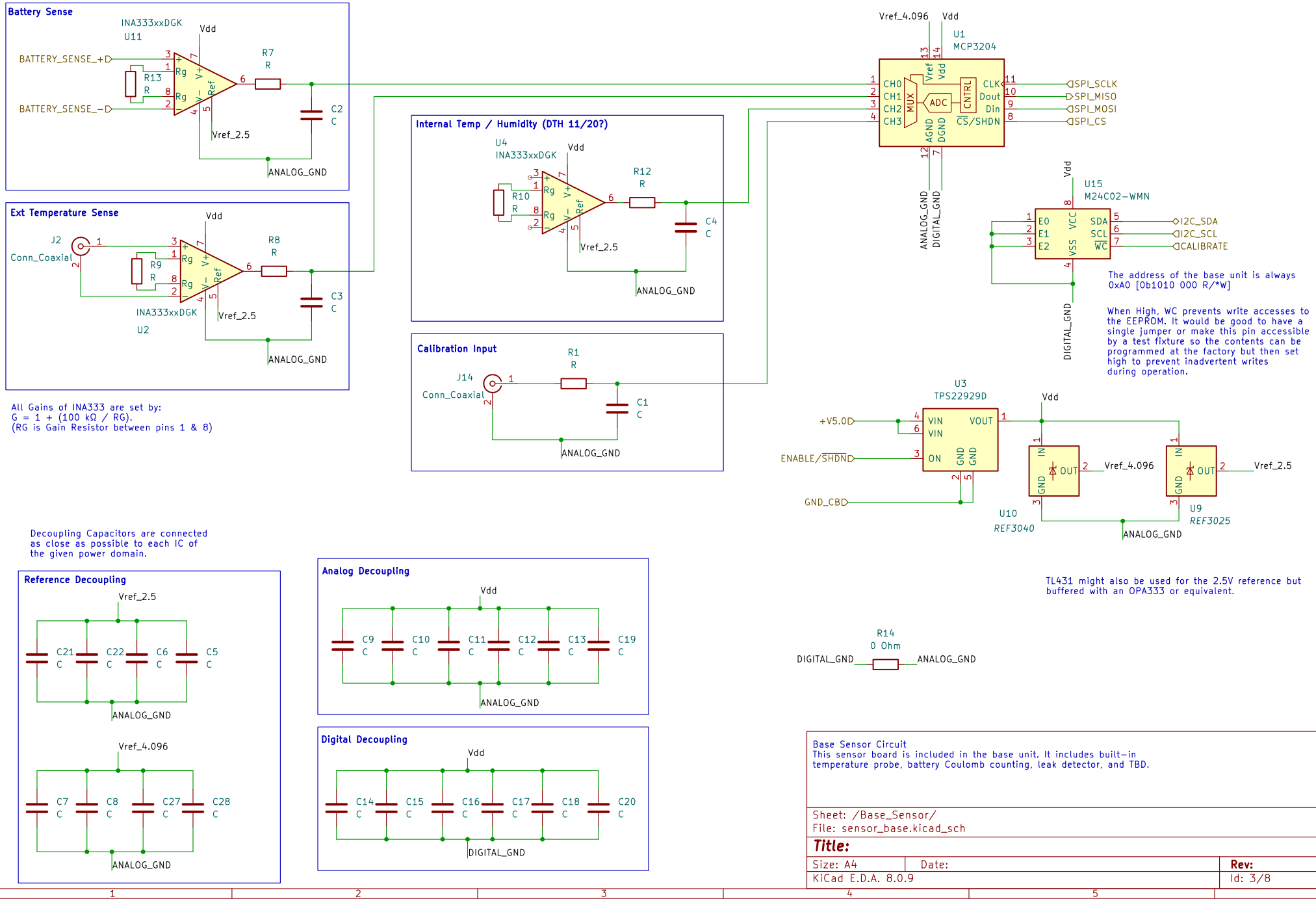
Place-holder for a 3.3V supply. Might not need this since the camera modules may have built-in 5V-3.3V regulators.

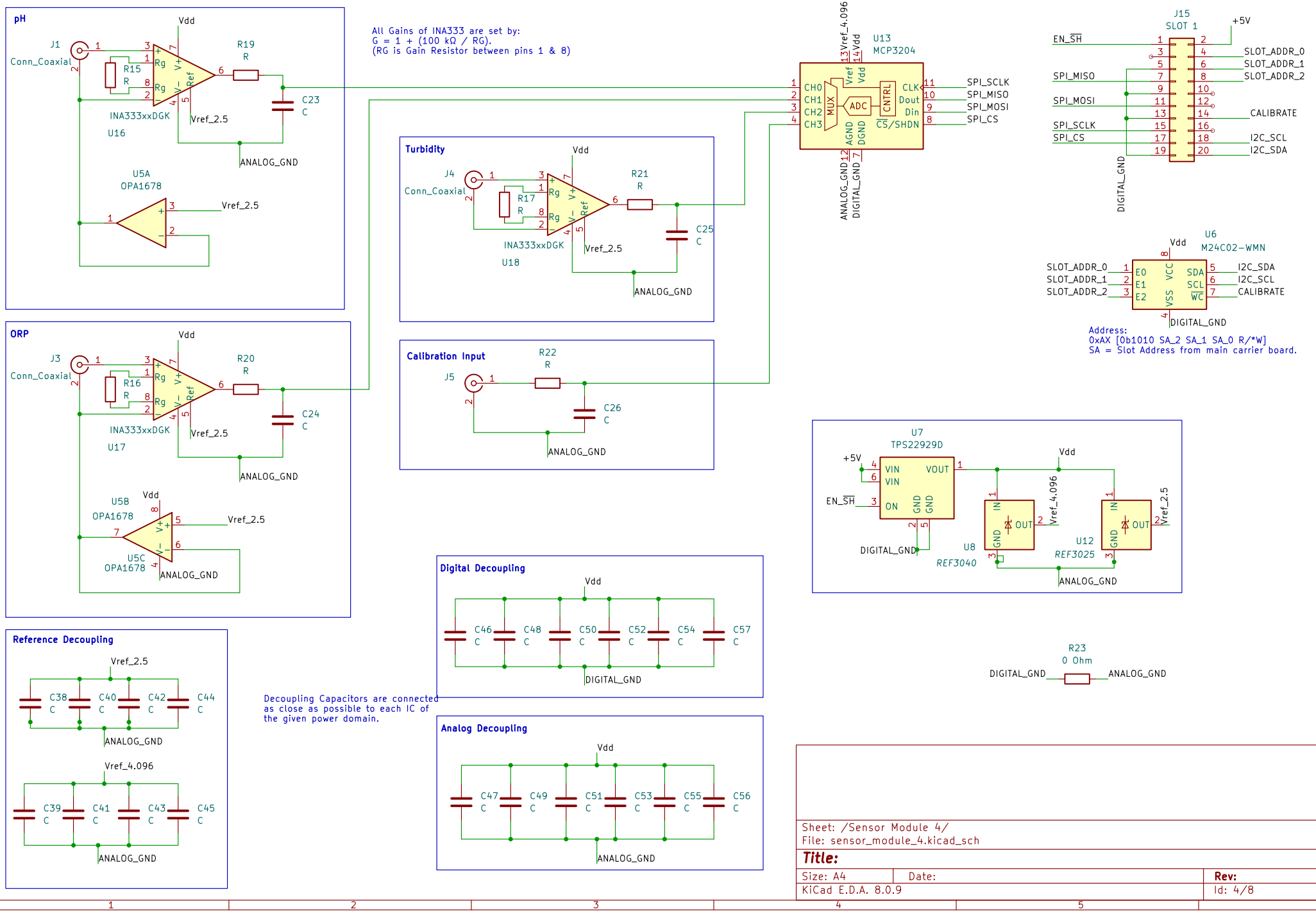


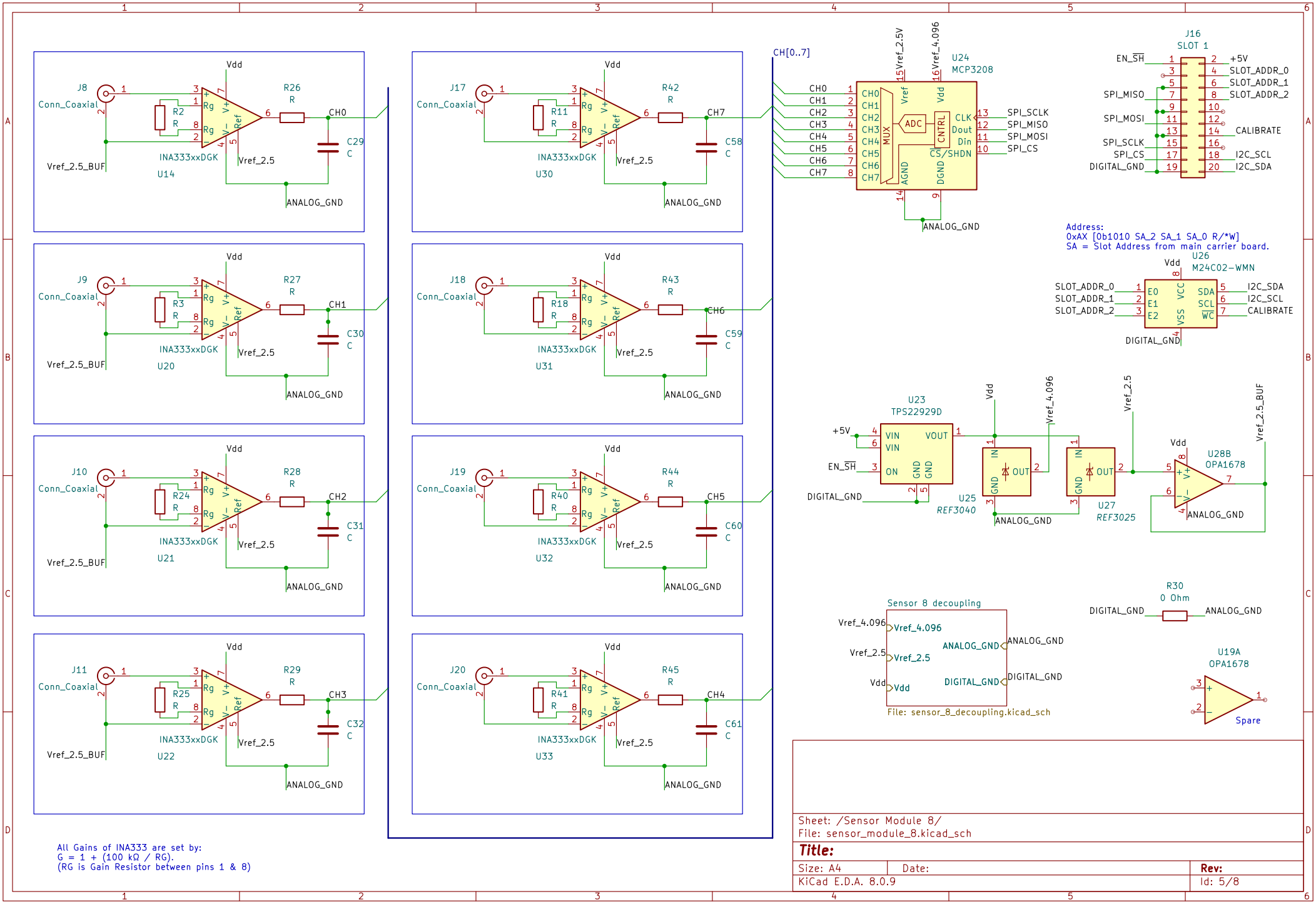

Sheet: /Power/
File: power.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. 8.0.9 | | Id: 2/8 |


Battery Sense
INA333xxDGK
U11
Vdd
BATTERY_SENSE_+
BATTERY_SENSE_-
R13
R
R7
R
C2
C
Vref_2.5
ANALOG_GND
Ext Temperature Sense
J2
Conn_Coaxial
R9
R
R8
R
C3
C
INA333xxDGK
U2
Vref_2.5
ANALOG_GND
All Gains of INA333 are set by:
G = 1 + (100 kΩ / RG).
(RG is Gain Resistor between pins 1 & 8)
Internal Temp / Humidity (DTH 11/20?)
U4
INA333xxDGK
Vdd
R10
R
R12
R
C4
C
Vref_2.5
ANALOG_GND
Calibration Input
J14
Conn_Coaxial
R1
R
C1
C
ANALOG_GND
Vref_4.096
Vdd
U1
MCP3204
CH0
CH1
CH2
CH3
MUX
ADC
CNTRL
Vref
Vdd
CLK
Dout
Din
CS/SHDN
AGND
DGND
SPI_SCLK
SPI_MISO
SPI_MOSI
SPI_CS
ANALOG_GND
DIGITAL_GND
Vdd
U15
M24C02-WMN
E0
E1
E2
VCC
VSS
SDA
SCL
WC
I2C_SDA
I2C_SCL
CALIBRATE
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
VOUT
ON
GND
Vdd
U10
REF3040
U9
REF3025
IN
OUT
GND
Vref_4.096
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
Decoupling Capacitors are connected
as close as possible to each IC of
the given power domain.
Reference Decoupling
Vref_2.5
C21
C22
C6
C5
C
ANALOG_GND
Vref_4.096
C7
C8
C27
C28
C
ANALOG_GND
Analog Decoupling
Vdd
C9
C10
C11
C12
C13
C19
C
ANALOG_GND
Digital Decoupling
Vdd
C14
C15
C16
C17
C18
C20
C
DIGITAL_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.
Sheet: /Base_Sensor/
File: sensor_base.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. 8.0.9
Id: 3/8


pH
J1
Conn_Coaxial
R15
R
R19
R
C23
C
INA333xxDGK
U16
Vref_2.5
ANALOG_GND
U5A
OPA1678
Vdd
All Gains of INA333 are set by:
G = 1 + (100 kΩ / RG).
(RG is Gain Resistor between pins 1 & 8)
Turbidity
J4
R17
R21
C25
U18
ORP
J3
R16
R20
C24
U17
U5B
U5C
Calibration Input
J5
R22
C26
U13
MCP3204
Vref_4.096
CH0
CH1
CH2
CH3
MUX
ADC
CNTRL
CLK
Dout
Din
CS/SHDN
AGND
DGND
SPI_SCLK
SPI_MISO
SPI_MOSI
SPI_CS
J15
SLOT 1
+5V
EN_SH
SLOT_ADDR_0
SLOT_ADDR_1
SLOT_ADDR_2
CALIBRATE
I2C_SCL
I2C_SDA
DIGITAL_GND
U6
M24C02-WMN
Address:
0xAX [0b1010 SA_2 SA_1 SA_0 R/*W]
SA = Slot Address from main carrier board.
U7
TPS22929D
VIN
VOUT
ON
GND
U8
REF3040
U12
REF3025
R23
0 Ohm
Digital Decoupling
C46
C48
C50
C52
C54
C57
Reference Decoupling
C38
C40
C42
C44
C39
C41
C43
C45
Analog Decoupling
C47
C49
C51
C53
C55
C56
Decoupling Capacitors are connected as close as possible to each IC of the given power domain.
Sheet: /Sensor Module 4/
File: sensor_module_4.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. 8.0.9
Id: 4/8


J8
Conn_Coaxial
R2
R
R26
R
CH0
C29
C
Vdd
Vref_2.5_BUF
INA333xxDGK
U14
Vref_2.5
ANALOG_GND
J9
R3
R27
CH1
C30
U20
J10
R24
R28
CH2
C31
U21
J11
R25
R29
CH3
C32
U22
J17
R11
R42
CH7
C58
U30
J18
R18
R43
CH6
C59
U31
J19
R40
R44
CH5
C60
U32
J20
R41
R45
CH4
C61
U33
CH[0..7]
U24
MCP3208
Vref_2.5V
Vref_4.096
CH0
CH1
CH2
CH3
CH4
CH5
CH6
CH7
MUX
ADC
CNTRL
CLK
Dout
Din
CS/SHDN
SPI_SCLK
SPI_MISO
SPI_MOSI
SPI_CS
AGND
DGND
J16
SLOT 1
EN_SH
+5V
SLOT_ADDR_0
SLOT_ADDR_1
SLOT_ADDR_2
SPI_MISO
SPI_MOSI
CALIBRATE
SPI_SCLK
SPI_CS
DIGITAL_GND
I2C_SCL
I2C_SDA
Address:
0xAX [0b1010 SA_2 SA_1 SA_0 R/*W]
SA = Slot Address from main carrier board.
U26
M24C02-WMN
E0
E1
E2
VCC
VSS
SDA
SCL
WC
U23
TPS22929D
VIN
VOUT
ON
GND
U25
REF3040
U27
REF3025
U28B
OPA1678
Sensor 8 decoupling
Vref_4.096
Vref_2.5
Vdd
File: sensor_8_decoupling.kicad_sch
R30
0 Ohm
U19A
OPA1678
Spare
All Gains of INA333 are set by:
G = 1 + (100 kΩ / RG).
(RG is Gain Resistor between pins 1 & 8)
Sheet: /Sensor Module 8/
File: sensor_module_8.kicad_sch
Title:
Size: A4
Date:
Rev:
KiCad E.D.A. 8.0.9
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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.

◇I2C_SDA
▷I2C_SCL

◁SPI_MISO
▷SPI_MOSI
▷SPI_SCLK
▷SPI_CS0
▷SPI_CS1
▷SPI_CS2

◁+5.0V
◁+3.3V
◇GND_CB

▷EN/$\overline{\text{SH\_0}}$
▷EN/$\overline{\text{SH\_1}}$
▷EN/$\overline{\text{SH\_2}}$

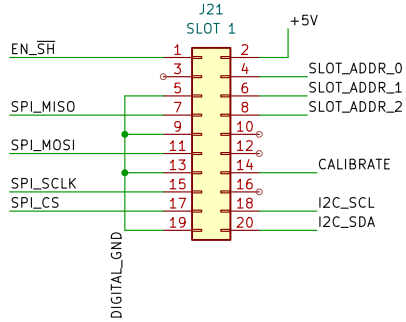
▷CALIBRATE

Sheet: /Micocontroller/
File: microcontroller.kicad_sch

**Title:**

| Size: A4 | Date: | **Rev:** |
|---|---|---|
| KiCad E.D.A. 8.0.9 | | Id: 6/8 |

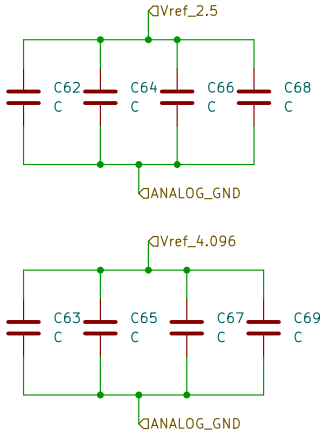
Some sensors will need to come with their own digital breakout boards (DO, CO2, EC, etc.) To support these, this board provides a common interface to the CPU and signal conditioning to those units.



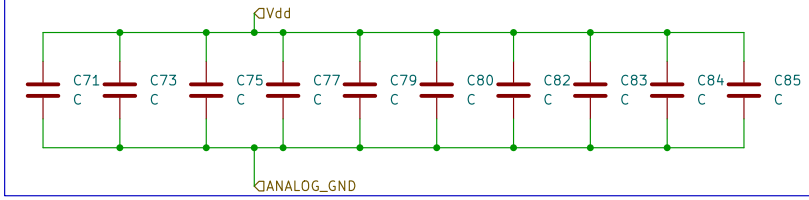

| | | |
|---|---|---|
| Sheet: /Digital Sensor Module 4/<br>File: digital_sensor_4.kicad_sch | | |
| **Title:** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. 8.0.9 | | Id: 7/8 |

Decoupling Capacitors are connected as close as possible to each IC of the given power domain.

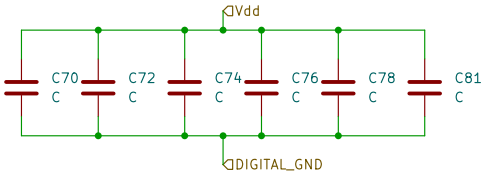
## Reference Decoupling




## Analog Decoupling




## Digital Decoupling




| | | |
|---|---|---|
| Sheet: /Sensor Module 8/Sensor 8 decoupling/ | | |
| File: sensor_8_decoupling.kicad_sch | | |
| **Title:** | | |
| Size: A4 | Date: | **Rev:** |
| KiCad E.D.A. 8.0.9 | | Id: 8/8 |