STATION BOARD v0.1 (VARIANT A)

ESP32-S3 · 12 V lead-acid battery · 2× RS485 master · LTE modem slot · AWS / weather station

POWER & MODEM

Power

Battery input: PTC, TVS, reverse P-FET,

INA226 + 10 mΩ shunt, buck 4.0 V (UVLO),

3V3 buck-boost, load switches, VSENS ×2

File: power.kicad_sch

Modem

MODEM 2x10 slot for an LTE card

bulk capacitance for 2 A bursts

PWRKEY / RESET / RI / DTR

File: modem.kicad_sch

CORE

MCU

ESP32-S3-WROOM-1-N16R8

USB-C + ESD, reset/boot, straps

TPL5010 external watchdog

File: mcu.kicad_sch

IO

I2C0: RV-3032 RTC + CR1220,

ADS1115 ADC, Qwiic port

microSD · status LED · user button

File: io.kicad_sch

SENSORS

RS485

2× THVD1426 auto-direction,

SM712, 120 Ω jumpers, GDT (DNP),

4-pole terminals with VSENS

File: rs485.kicad_sch

Sensor ports

2× analog (0-3.3 V / 0-10 V / 4-20 mA)

2× pulse (ULP counting)

PV voltage sense

File: ports.kicad_sch

VIN (battery) → VSYS 4.0 V buck (hardware UVLO) → VMODEM switch and 3V3. 3V3_SENS, 3V3_SD, VMODEM,

VSENS1 and VSENS2 are switched by GPIOs with 100 kΩ pull-downs: all OFF at boot.

'calc' = computed from datasheet equations. Specification: docs/station-v0.1.md.

Generated by hardware/tools/gen_station.py — see hardware/station/README.md.

Station board (variant A) — see docs/station-v0.1.md

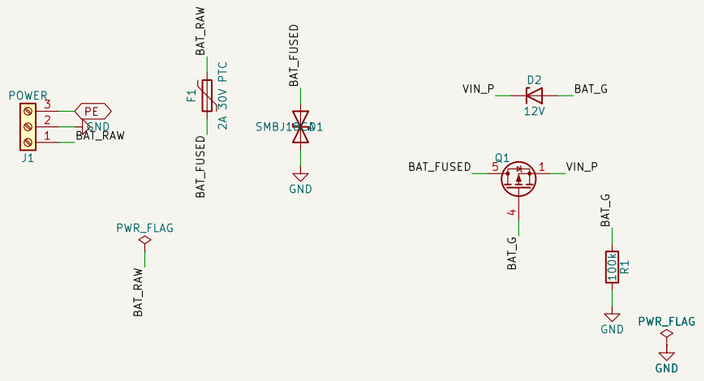
Sheet: /
File: station.kicad_sch

Title: Station Board v0.1 — block diagram

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 1/7

BATTERY INPUT

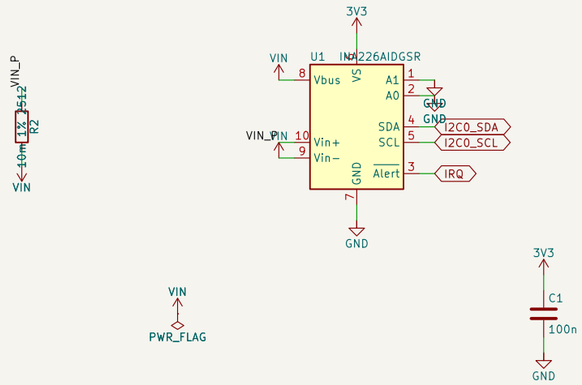
12 V lead-acid / LiFePO4 (9–18 V) · PTC · TVS · reverse P-FET



SMBJ18CA clamps below the 38 V rating of the buck and the INA226 (12 V systems only).

CURRENT MONITOR — INA226

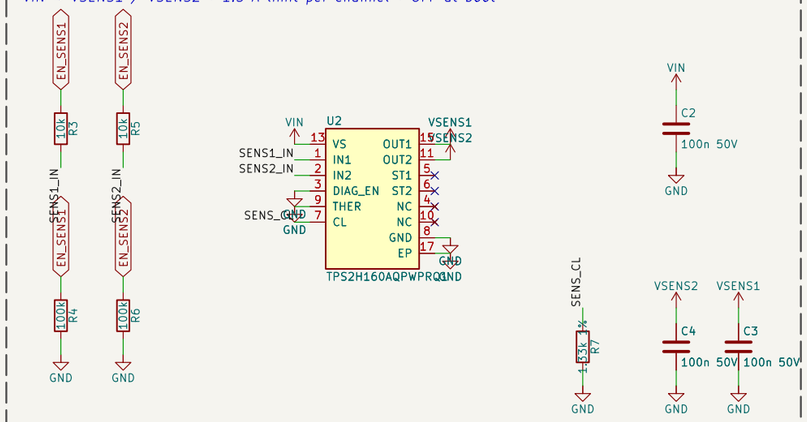
10 mΩ shunt · I2C 0x40 · whole board + sensors + modem



Route Vin+/Vin− as a Kelvin pair from the shunt pads. CAL = 2560 for 200 µA/bit.

SENSOR SUPPLY — TPS2H160

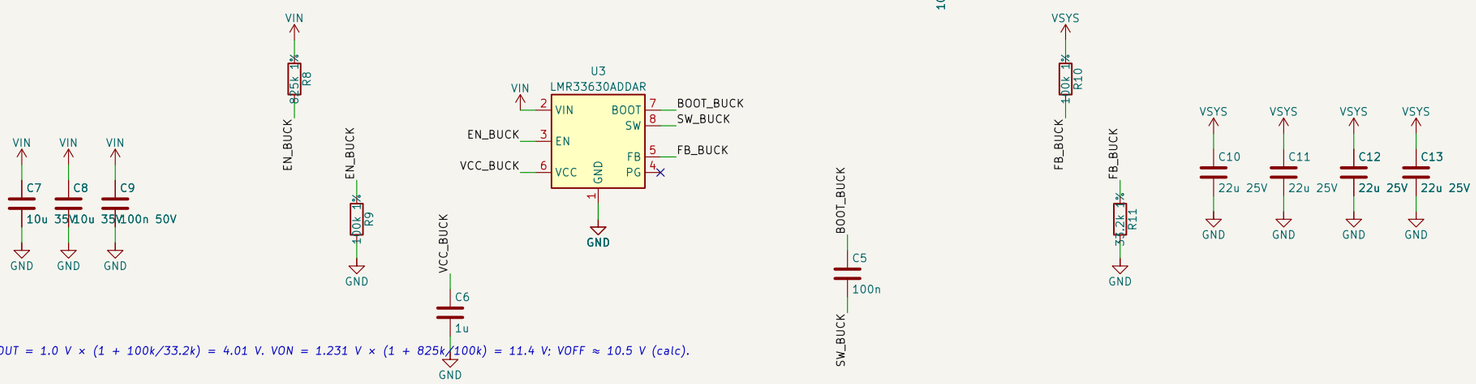
VIN → VSENS1 / VSENS2 · 1.5 A limit per channel · OFF at boot



R(CL) = 0.8 V × 2500 / 1.5 A. DIAG_EN low: ST1/ST2 unused.

VSYS 4.0 V — LMR33630A

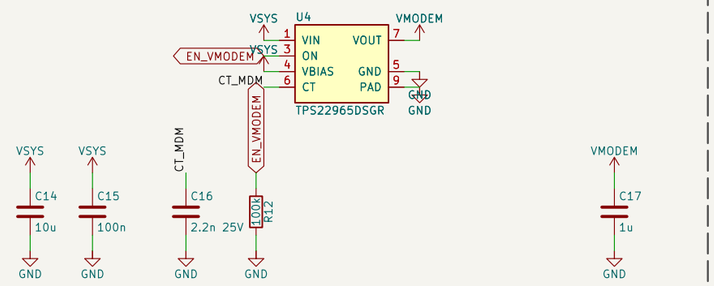
400 kHz · 3 A · 24 µA Iq · EN divider = UVLO (on 11.4 V, off 10.5 V)



VOUT = 1.0 V × (1 + 100k/33.2k) = 4.01 V. VON = 1.231 V × (1 + 825k/100k) = 11.4 V; VOFF ≈ 10.5 V (calc).

MODEM SUPPLY — TPS22965

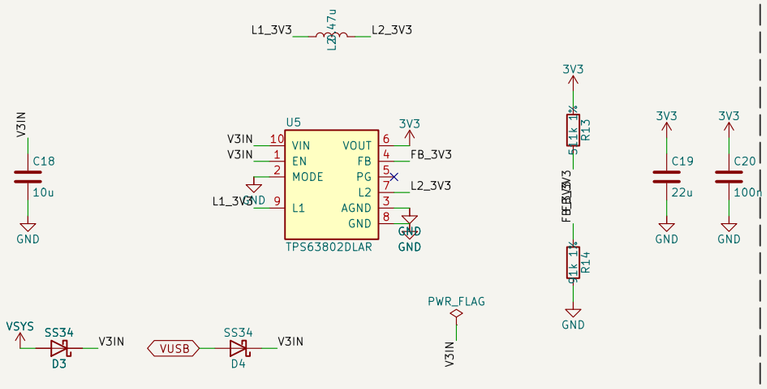
VSYS → VMODEM · 6 A switch, 2 A bursts



Bulk 470 µF + 100 µF sits at the MODEM header.

3V3 MAIN — TPS63802

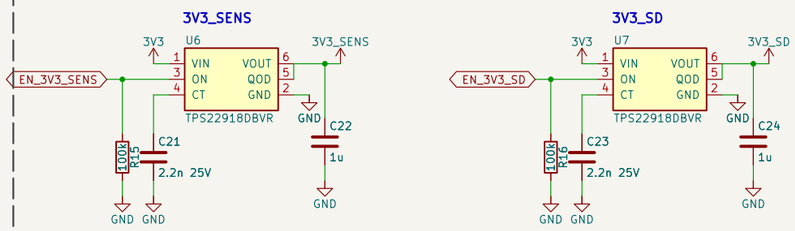
Buck-boost · always on · 11 µA Iq · fed from VSYS or USB



VOUT = 0.5 V × (1 + 511k/91k) = 3.31 V. USB powers only 3V3 (bench / upload).

SWITCHED 3V3 RAILS

TPS22918 ×2 · OFF at boot (EN pulled down) · CT 2.2 nF



Station board (variant A) — see docs/station-v0.1.md

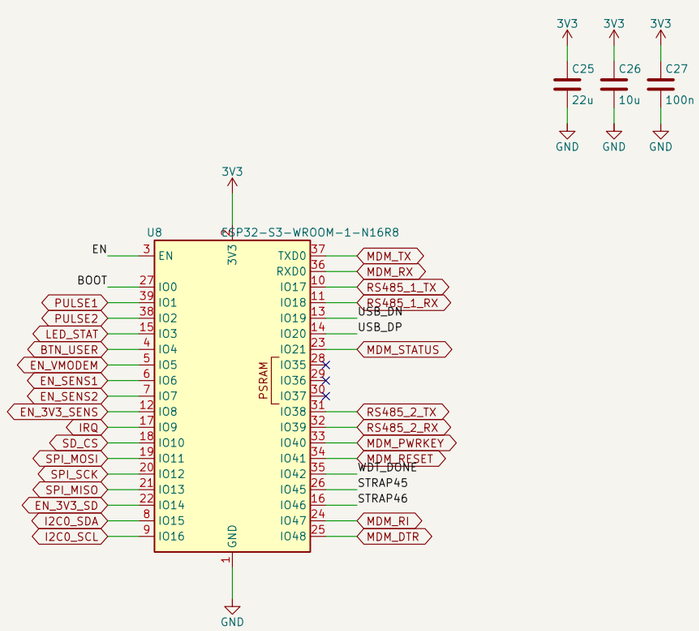
Sheet: /Power/
File: power.kicad_sch

Title: Power: 12 V battery input, INA226, 4.0 V buck (UVLO), modem switch, …

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 2/7

ESP32-S3 MODULE

ESP32-S3-WROOM-1-N16R8 · GPIO map per docs/station-v0.1.md

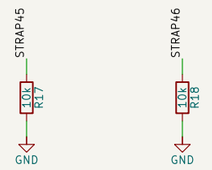


IO35–IO37 drive the octal PSRAM inside the module: leave unconnected.

Modem on UART0 (IO43/44): the ROM boot log goes there while VMODEM is still off.

STRAPPING PINS

IO45 low = 3.3 V flash · IO46 low for download



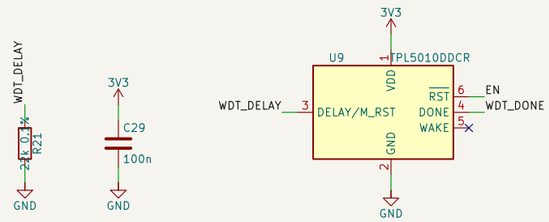
RESET & BOOT

EN RC delay · BOOT button on IO0



EXTERNAL WATCHDOG

TPL5010 · ~60 s · pulls EN low if WDT_DONE is not pulsed

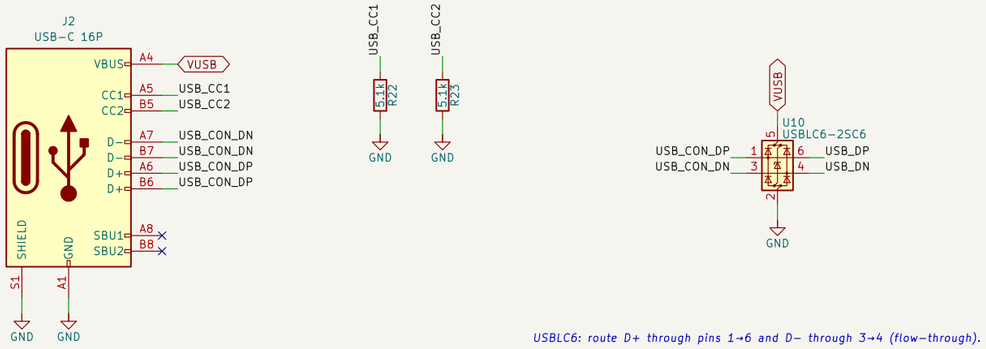


22 kΩ → t_IP ≈ 60 s (TPL5010 table). RSTn is open-drain into the EN RC (10k pull-up).

Firmware must pulse WDT_DONE (IO42) at least once per period.

USB-C

Flashing, debug console, bench power (VUSB → 3V3 regulator only)



USBLC6: route D+ through pins 1→6 and D− through 3→4 (flow-through).

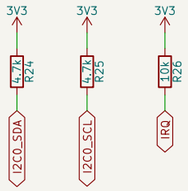
CC1/CC2 5.1k to GND: the board is a USB sink.

Station board (variant A) — see docs/station-v0.1.md

Sheet: /MCU/		
File: mcu.kicad_sch		
Title: MCU: ESP32-S3 module, USB-C, reset/boot, straps, watchdog		
Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 3/7

I2C0 BUS & IRQ

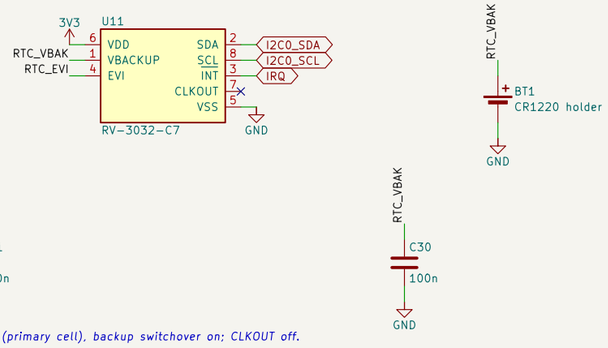
Pull-ups to the always-on 3V3



IRQ (IO9) = wired-OR of RTC INT
and INA226 ALERT (both open-drain).
0x40 INA226 · 0x48 ADS1115 · 0x51 RV-3032

RTC — RV-3032-C7

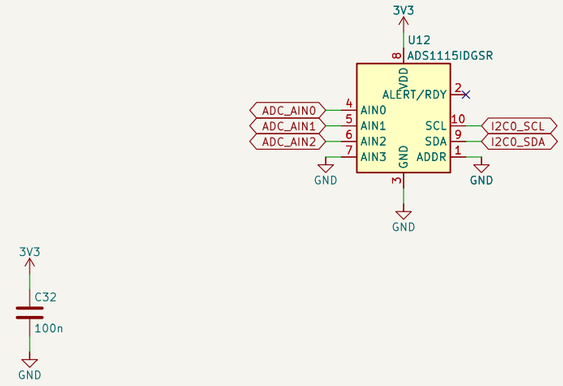
±2.5 ppm TCXO · 160 nA · I2C 0x51 · CR1220 backup



Firmware: trickle charger off (primary cell), backup switchover on; CLKOUT off.

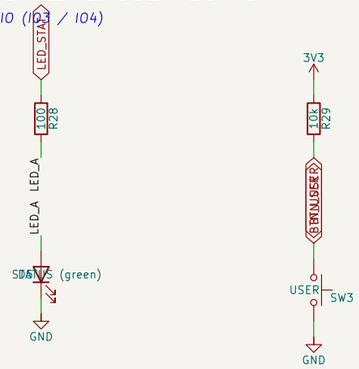
ADC — ADS1115

16-bit · I2C 0x48 · AIN0/1 analog ports · AIN2 PV sense · polled



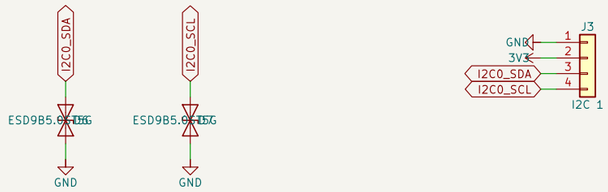
STATUS LED & USER BUTTON

Direct GPIO (IO3 / IO4)



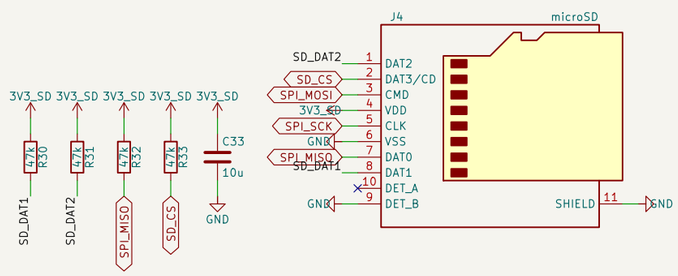
I2C PORT (QWIIC)

JST-SH 4P · I2C0 · always-on 3V3 (an unpowered device would hold the bus)



microSD

SPI mode · powered from 3V3_SD



Station board (variant A) — see docs/station-v0.1.md

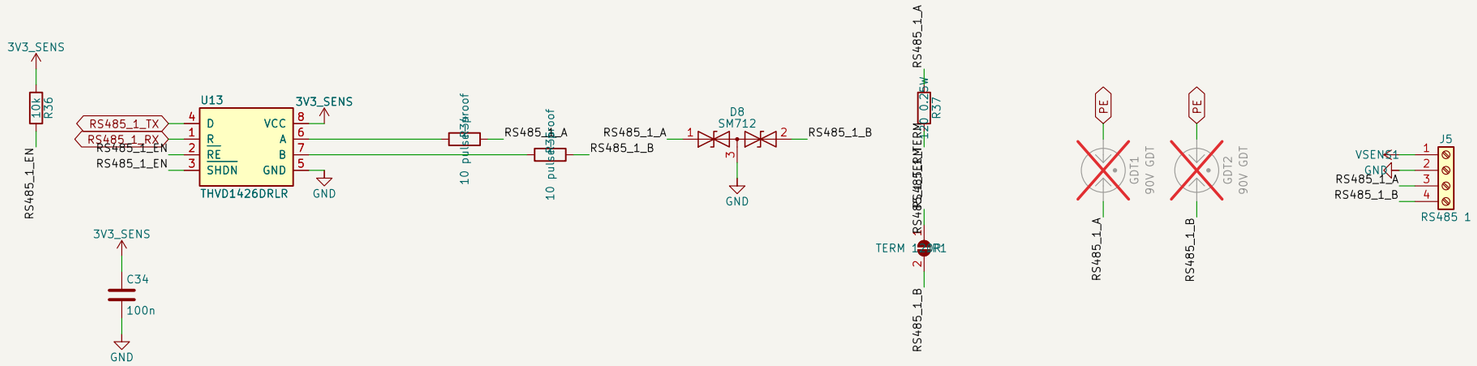
Sheet: /IO/
File: io.kicad_sch

Title: I/O: I2C0 bus, RTC with backup cell, ADC, microSD, status LED, Qwiic

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 4/7

RS485 PORT 1

THVD1426 auto-direction (A3) · UART1 · sensors powered from VSENS1, switched by EN_SENS1



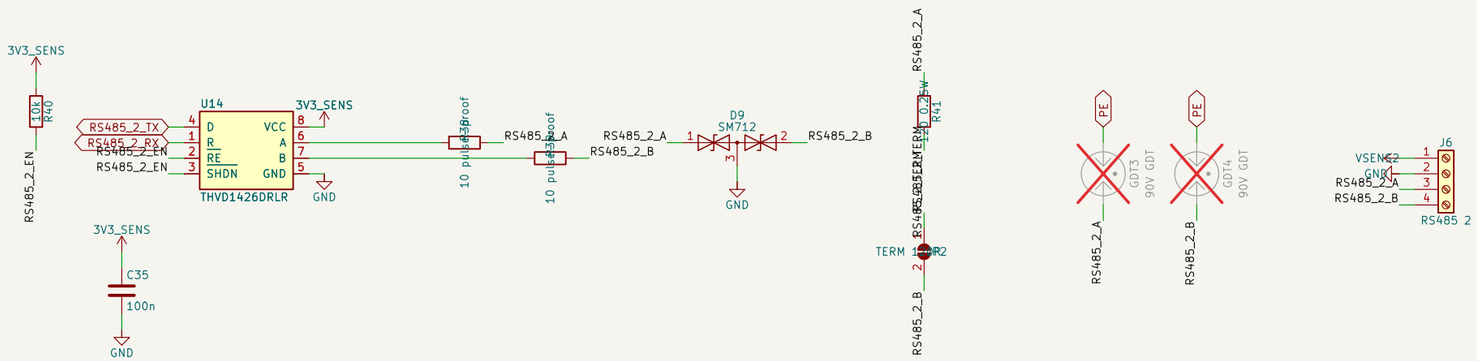
RE and SHDN high: receiver on except while transmitting. Built-in bus-idle fail-safe.

Close TERM only at the cable end. GDTs (A/B to PE) not fitted until mast earthing is decided.

Pin order: 1 VSENS (battery voltage, switched) · 2 GND · 3 A · 4 B.

RS485 PORT 2

THVD1426 auto-direction (A3) · UART2 · sensors powered from VSENS2, switched by EN_SENS2



RE and SHDN high: receiver on except while transmitting. Built-in bus-idle fail-safe.

Close TERM only at the cable end. GDTs (A/B to PE) not fitted until mast earthing is decided.

Pin order: 1 VSENS (battery voltage, switched) · 2 GND · 3 A · 4 B.

Station board (variant A) — see docs/station-v0.1.md

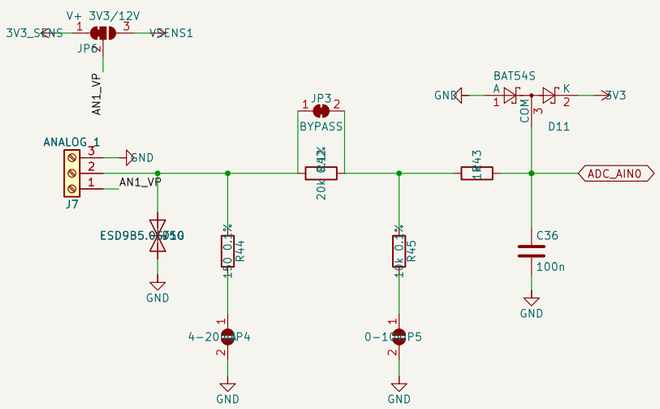
Sheet: /RS485/
File: rs485.kicad_sch

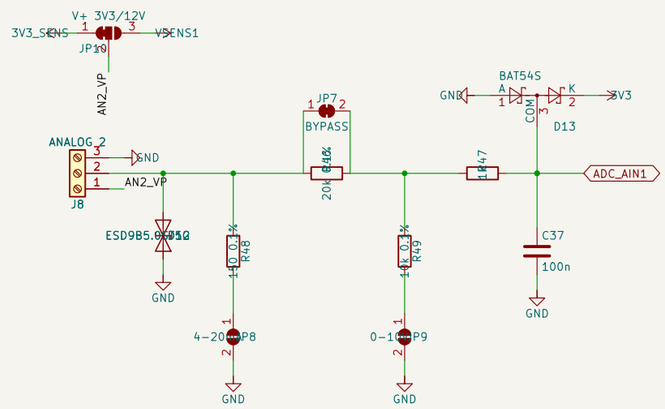
Title: RS485 ×2: THVD1426, protection, termination, switched sensor supply

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 5/7

ANALOG INPUTS ×2

0–3.3 V · 0–10 V · 4–20 mA (solder jumpers) → ADS1115 AIN0 / AIN1



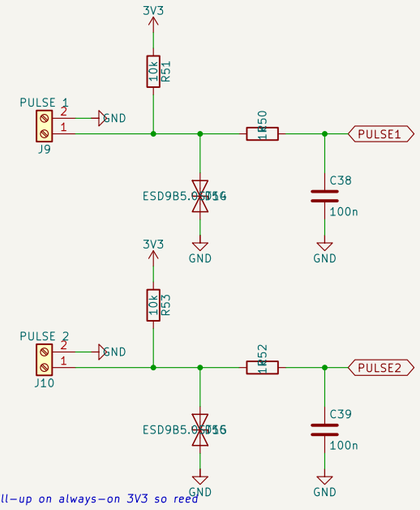


0–3.3 V: BYPASS closed (default). 0–10 V: cut BYPASS, close 0–10V (÷3).

4–20 mA: BYPASS + 4–20mA closed (20 mA × 150 Ω = 3.0 V). V+ jumper: 3V3_SENS (default) or VSENS1.

PULSE INPUTS ×2

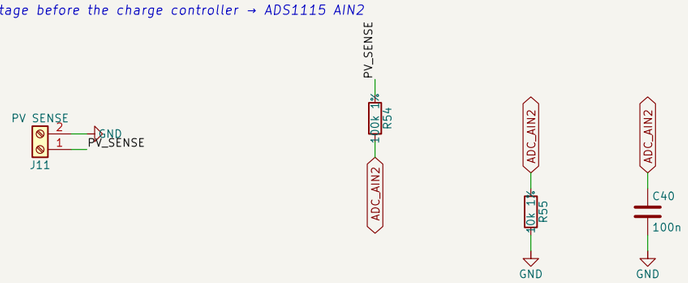
Rain gauge / anemometer · ULP counts in deep sleep



Pull-up on always-on 3V3 so reed contacts keep counting in deep sleep.

PV VOLTAGE SENSE (OPTIONAL)

Panel voltage before the charge controller → ADS1115 AIN2



ADC_AIN2 = PV / 11: 0–36 V. The 100k limits the clamp current above that.

Station board (variant A) — see docs/station-v0.1.md

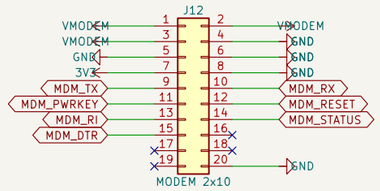
Sheet: /Sensor ports/
File: ports.kicad_sch

Title: Sensor ports: analog ×2, pulse ×2, PV voltage sense

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 6/7

MODEM SLOT

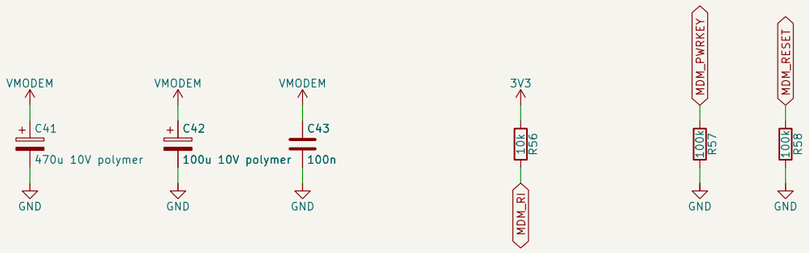
2x10 header, 2.54 mm · pinout of docs/spec-v0.1.md · 3.3 V logic · ID pins unused



Pin 9 MDM_TX = ESP32 → modem (TXD0) · pin 10 MDM_RX = modem → ESP32 (RXD0).

Pin 7: 3V3 reference for the card's 1.8 V level shifter (max 50 mA).

Card type is detected with AT commands; ID0/ID1 (17/18) are left open.



PWRKEY/RESET pull-downs: the GPIOs float until firmware configures them.

Station board (variant A) — see docs/station-v0.1.md

Sheet: /Modem/
File: modem.kicad_sch

Title: MODEM slot (2x10) for an LTE card, bulk capacitance

Size: A3	Date: 2026-10-18	**Rev: 0.1**
KiCad E.D.A. 10.0.8		Id: 7/7