SHPI.zero prototype

Functional schematic / population overview

Functional net names and modular circuit groups

Populated circuit at the front / non-populated options at the back

Raspberry Pi Zero / DPI interface

Sheet 02 | 29 components

Display / charge pumps / supply

Sheet 03 | 26 components

Display / RGB and timing filters

Sheet 04 | 22 components

Supply / current measurement / backlight

Sheet 05 | 20 components

ATmega32U4 / clock / reset / ISP

Sheet 06 | 24 components

RS485 / fan / sensor heater

Sheet 07 | 20 components

SPI level shifter / radio modules

Sheet 08 | 8 components

USB selection / protection / output

Sheet 09 | 10 components

I2C level / climate / air quality / light

Sheet 10 | 20 components

Motion / temperature / thermal imaging

Sheet 11 | 18 components

Analog gas sensors / NTC

Sheet 12 | 6 components

DNP / Supply / current measurement / backlight

Sheet 13 | 1 component

DNP / ATmega32U4 / clock / reset / ISP

Sheet 14 | 1 component

DNP / RS485 / fan / sensor heater

Sheet 15 | 1 component

DNP / SPI level shifter / radio modules

Sheet 16 | 3 components

DNP / I2C expansion / ADC / DAC / RTC

Sheet 17 | 19 components

DNP / I2C level shifter / climate / air quality / light

Sheet 18 | 6 components

DNP / Motion / temperature / thermal imaging

Sheet 19 | 11 components

DNP / Analog gas sensors / NTC

Sheet 20 | 3 components

DNP / USB audio / HS100B

Sheet 21 | 20 components

DNP / Audio power amplifier / microphone

Sheet 22 | 16 components

DNP / SAMD21 / expansion / reference options

Sheet 23 | 15 components

Identical global net names connect the functional sheets.

Non-populated options are marked with DNP and a cross.

SHPI

Sheet: /
File: SHPI-zero-prototype.kicad_sch

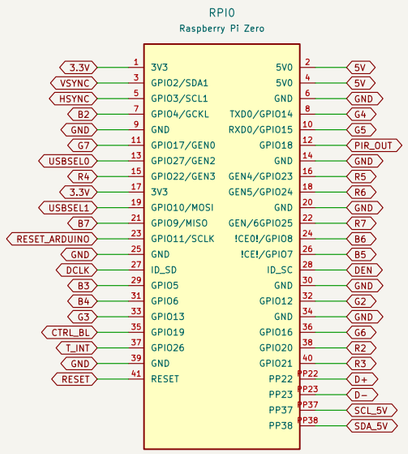
Title: SHPI.zero prototype / Function overview

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 1/23

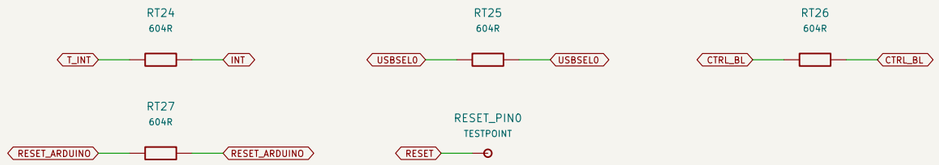
Raspberry Pi Zero / DPI interface

Pi module, GPIO and DPI assignment with series termination.

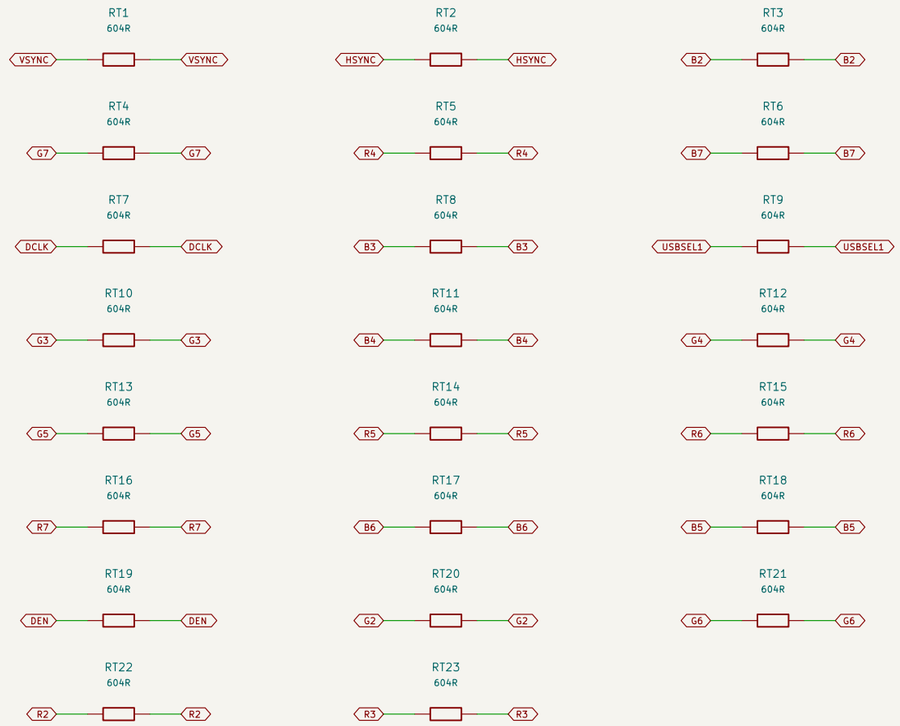
Raspberry Pi Zero



Pi control lines / touch interrupt



DPI additional circuitry



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Raspberry Pi Zero / DPI interface/
File: 01_Raspberry_Pi.kicad_sch

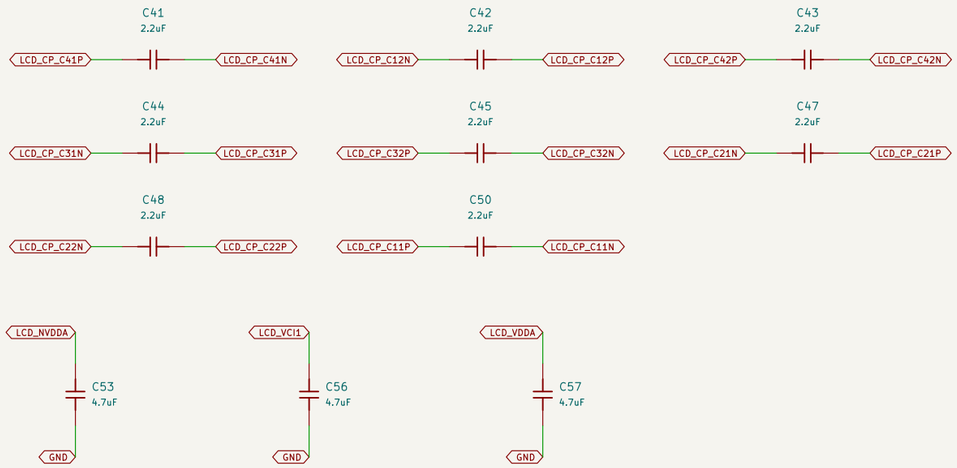
Title: SHPI.zero proto / Raspberry Pi

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 2/23

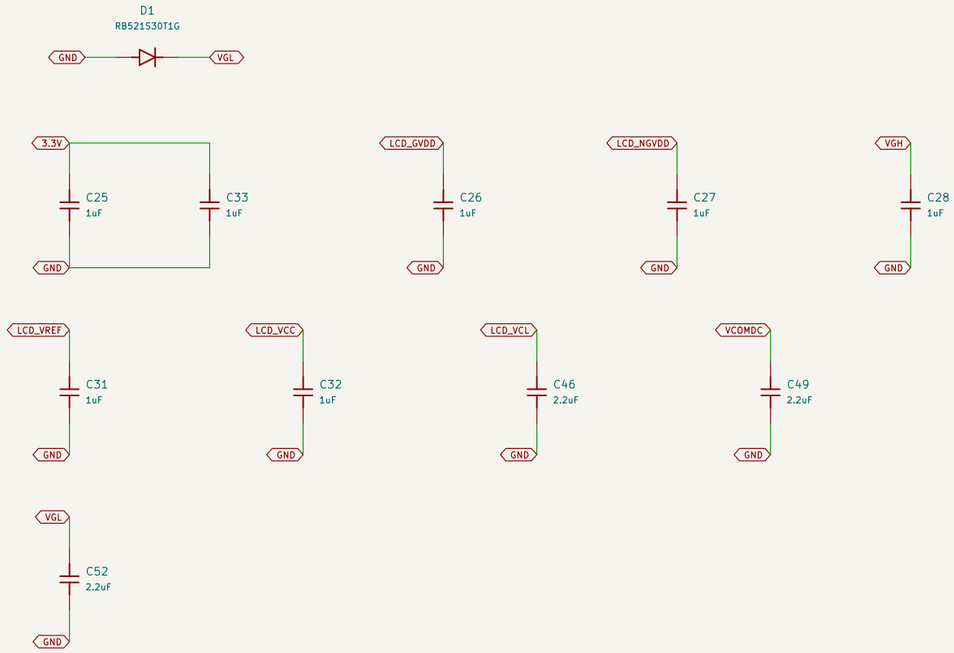
Display / charge pumps / supply

70-pin display/touch connector with local pump and support capacitors and ground contacts.

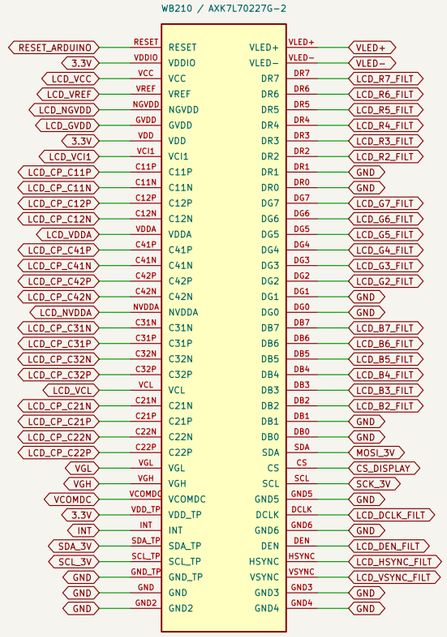
Display charge pumps



Display supplies



WB210 display/touch connection



Display ground contacts



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Display / charge pumps / supply/
File: 02_Display_Connector.kicad_sch

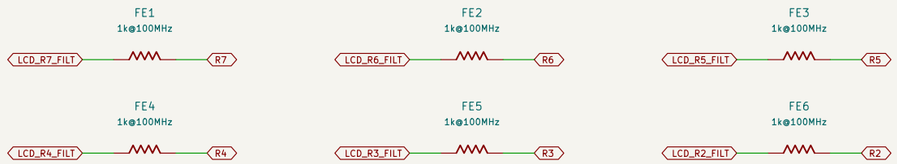
Title: SHPI.zero proto / Display Connector

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 3/23

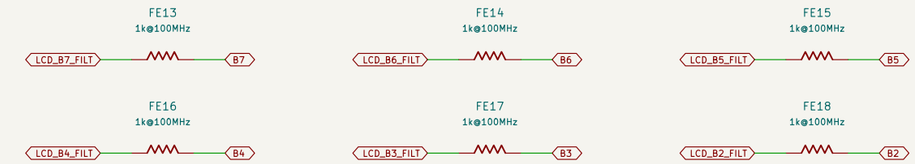
Display / RGB and timing filters

Signal paths between Pi DPI and display connector, sorted by red/green/blue/timing.

Red bus R2...R7



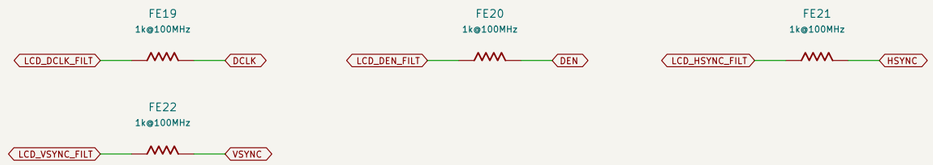
Blue bus B2...B7



Green bus G2...G7



DPI timing



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Display / RGB and timing filters/
File: 03_Display_Filter.kicad_sch

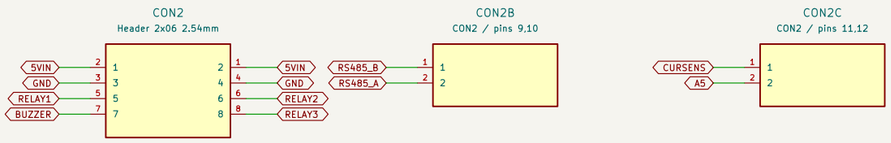
Title: SHPI.zero proto / Display Filter

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 4/23

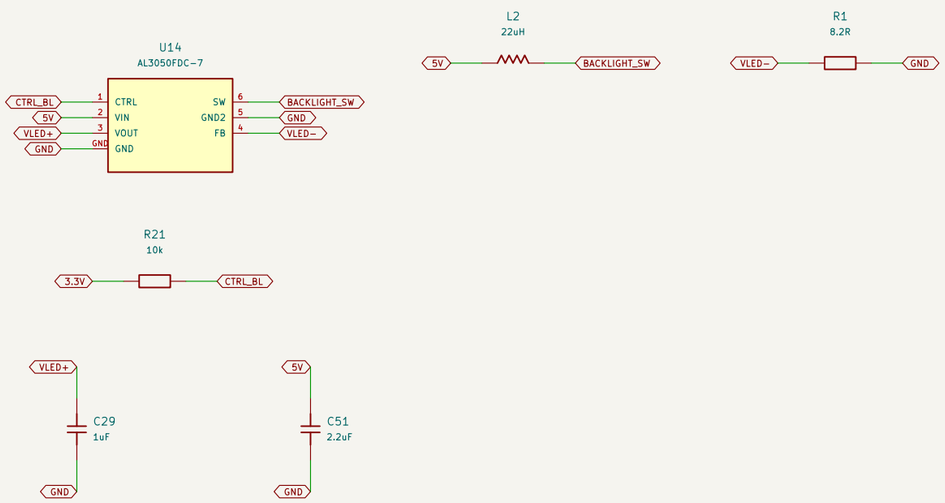
Supply / current measurement / backlight

5 V supply input, INA219 current measurement and AL3050 LED driver.

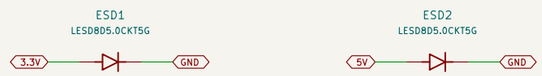
CON2 / 2x06 supply and control connector



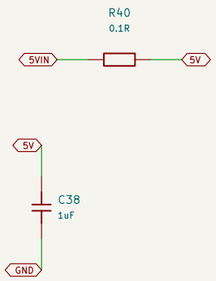
AL3050 backlight driver



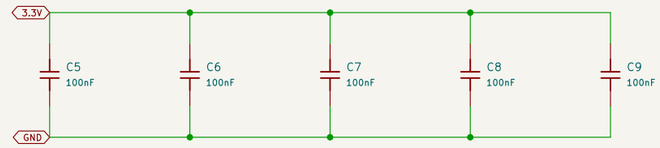
Supply protection



INA219 current measurement



Common 3.3 V decoupling



BOM decoupling / I2C options



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Supply / current measurement / backlight/
File: 04_Power_Backlight.kicad_sch

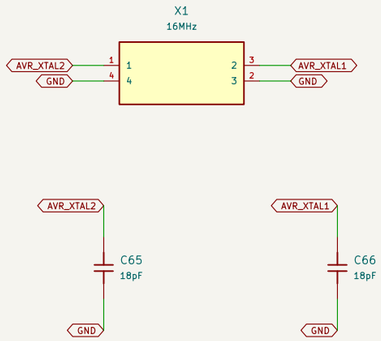
Title: SHPI.zero proto / Power Backlight

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 5/23

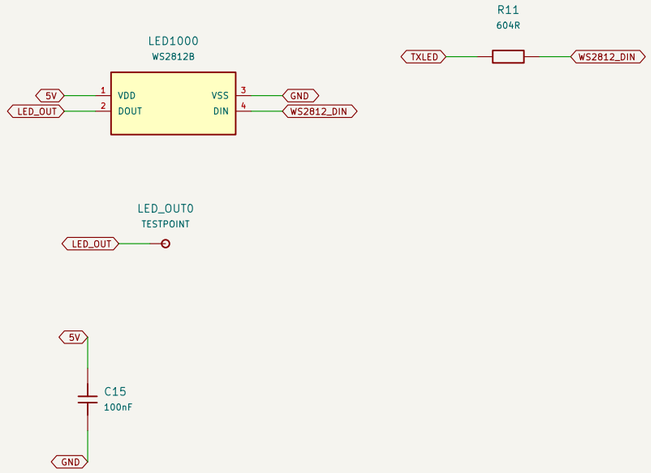
ATmega32U4 / clock / reset / ISP

AVR main controller with supply, USB termination and programming interface.

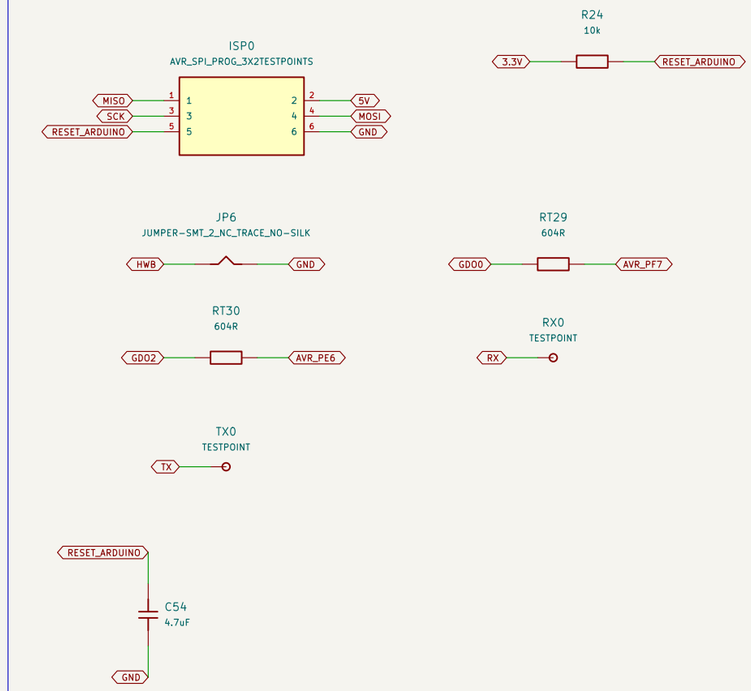
AVR clock



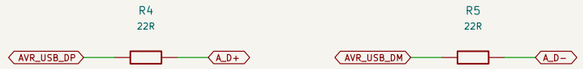
WS2812 status / expansion



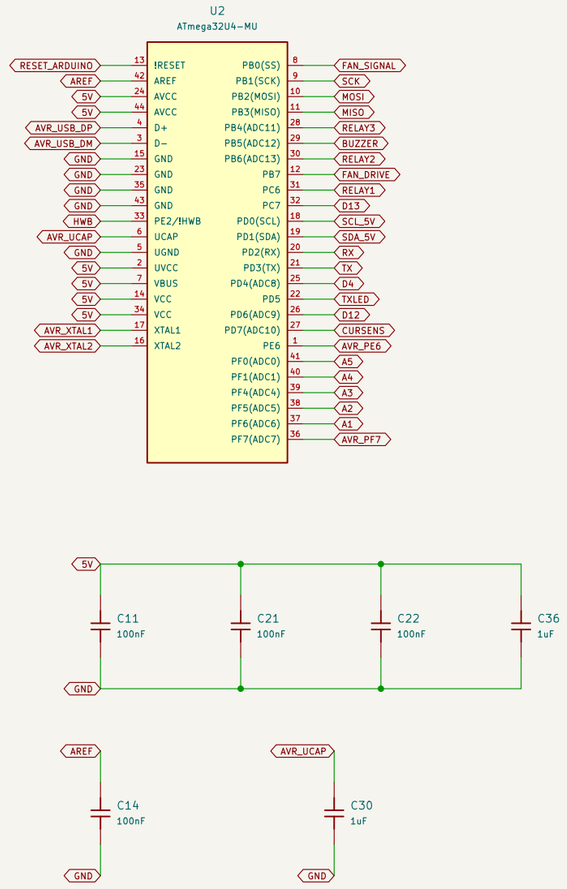
Reset / HWB / ISP



AVR USB termination



ATmega32U4



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /ATmega32U4 / clock / reset / ISP/
File: 05_ATmega32U4.kicad_sch

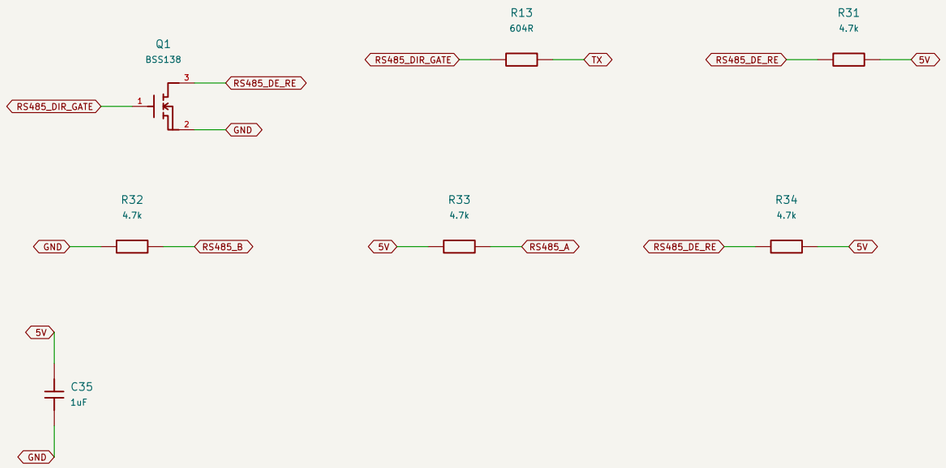
Title: SHPI.zero proto / ATmega32U4

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 6/23

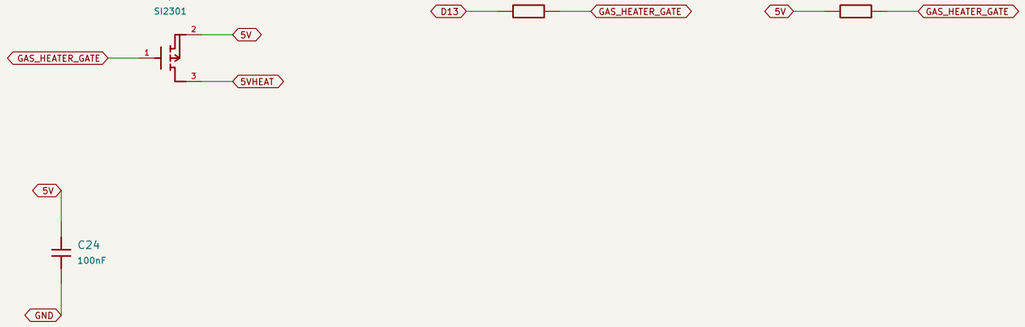
RS485 / fan / sensor heater

LTC485 with automatic direction control and two high-side switching stages.

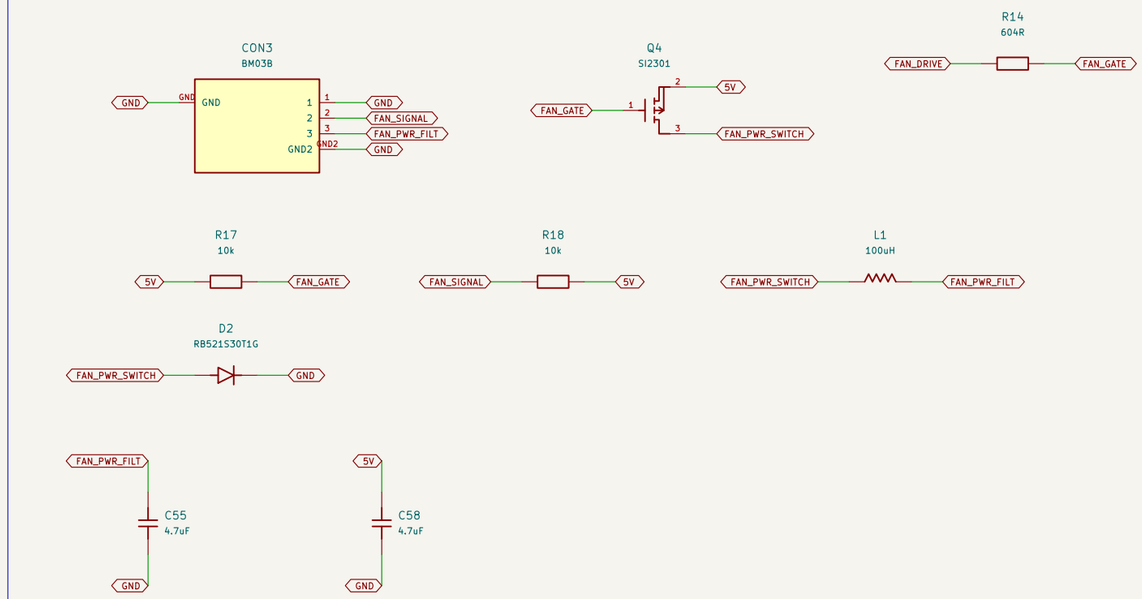
RS485 transceiver / direction



Gas sensor heater



Fan output



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /RS485 / fan / sensor heater/
File: 06_Outputs_RS485.kicad_sch

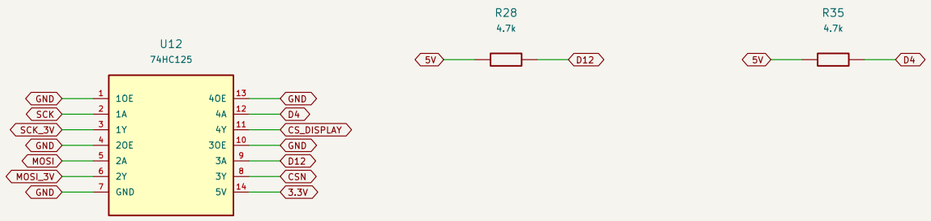
Title: SHPI.zero proto / Outputs RS485

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 7/23

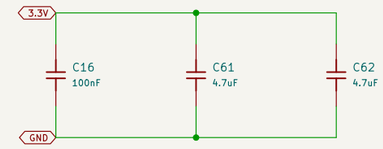
SPI level shifter / radio modules

74HC125 as SPI level shifter; CC1101 and RFM69 as options.

SPI level shifter



CC1101 module



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /SPI level shifter / radio modules/
File: 07_Radio_SPI.kicad_sch

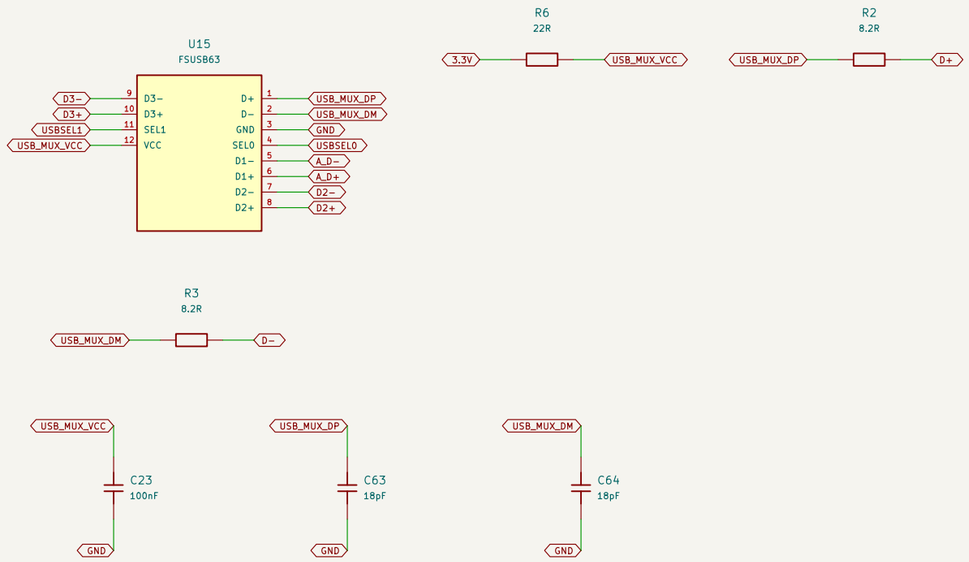
Title: SHPI.zero proto / Radio SPI

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 8/23

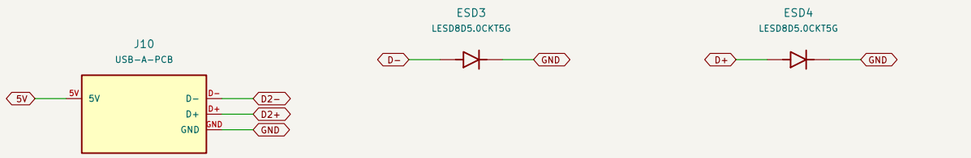
USB selection / protection / output

FSUSB63 between Raspberry Pi USB and AVR, USB-A contacts, audio codec and SAMD21.

FSUSB63 USB multiplexer



USB-A contacts / protection



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /USB selection / protection / output/
File: 08_USB_Mux.kicad_sch

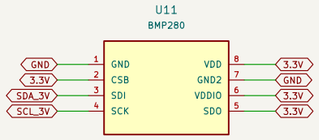
Title: SHPI.zero proto / USB Mux

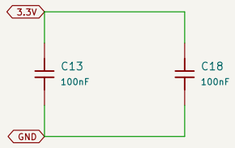
Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 9/23

I2C level / climate / air quality / light

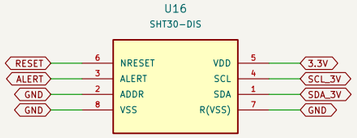
Level shifter and digital environmental sensors, logically grouped by sensor function.

BMP/BME280 / BME680 options





SHT31 / HTU21D





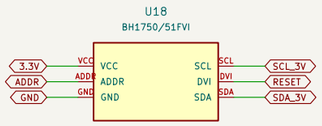


CCS811 / compensation





BH1751 / sensor reset



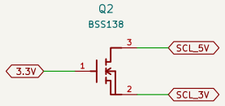


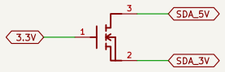






I2C 5V↔3.3V / protection















SHPI.zero prototype | Functional schematic

SHPI

Sheet: /I2C level / climate / air quality / light/
File: 10_I2C_Climate.kicad_sch

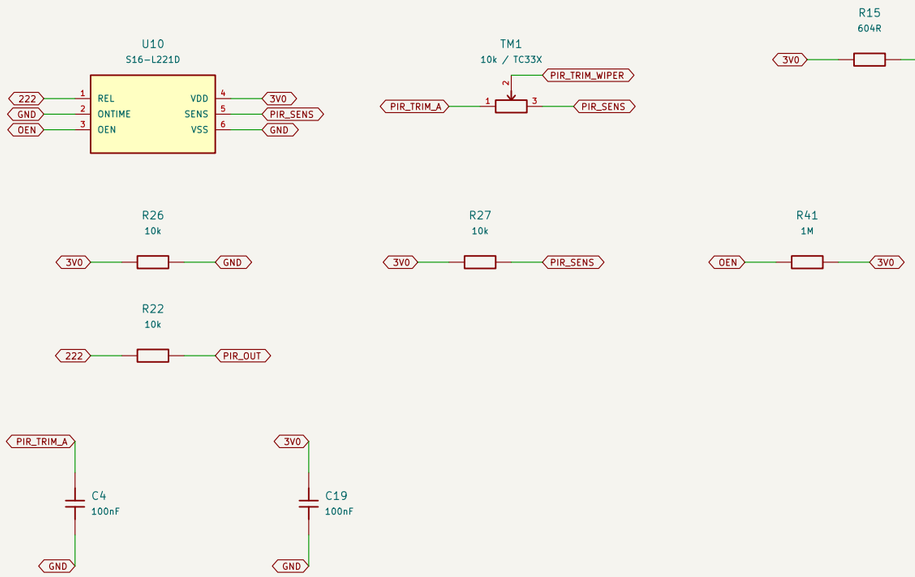
Title: SHPI.zero proto / I2C Climate

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 10/23

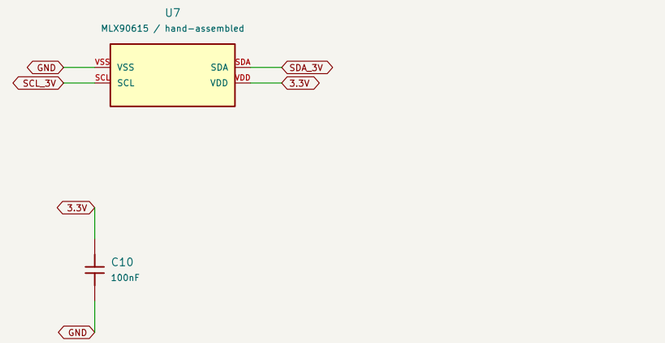
Motion / temperature / thermal imaging

PIR evaluation, MLX90615, AMG8833 and MPU-9250.

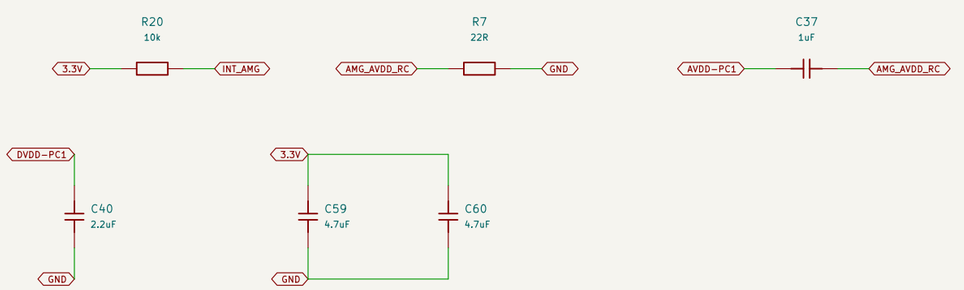
PIR S16-L221D / TM1



MLX90615 temperature



AMG8833 thermal imaging



MPU-9250 IMU



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Motion / temperature / thermal imaging/
File: 11_Motion_Thermal.kicad_sch

Title: SHPI.zero proto / Motion Thermal

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 11/23

Analog gas sensors / NTC

MiCS-5524, TGS2600 and analog evaluation at the AVR.

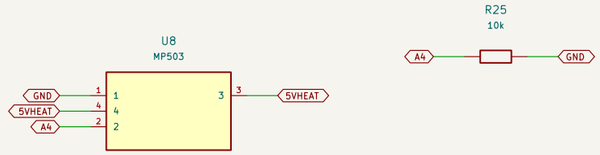
MICS-5524 / heating resistors



NTC / current input



TGS2600



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /Analog gas sensors / NTC/
File: 12_Gas_Analog.kicad_sch

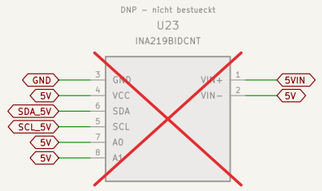
Title: SHPI.zero proto / Gas Analog

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 12/23

DNP / Options: Supply / current measurement / backlight

DNP = not populated (option).

INA219 current measurement



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: Supply / current measurement / backlight/
File: DNP_04_Power_Backlight.kicad_sch

Title: SHPI.zero proto / DNP: Power Backlight

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 13/23

DNP / Options: ATmega32U4 / clock / reset / ISP

DNP = not populated (option).

ATmega32U4



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: ATmega32U4 / clock / reset / ISP/
File: DNP_05_ATmega32U4.kicad_sch

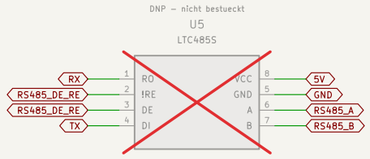
Title: SHPI.zero proto / DNP: ATmega32U4

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 14/23

DNP / Options: RS485 / fan / sensor heater

DNP = not populated (option).

RS485 transceiver / direction



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: RS485 / fan / sensor heater/
File: DNP_06_Outputs_RS485.kicad_sch

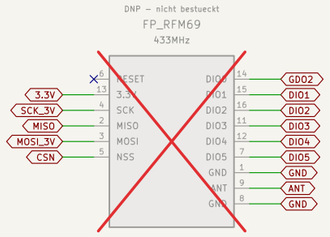
Title: SHPI.zero proto / DNP: Outputs RS485

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 15/23

DNP / Options: SPI level shifter / radio modules

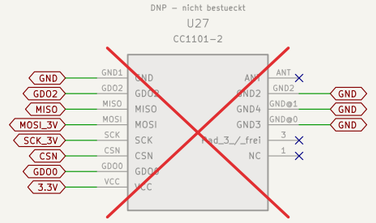
DNP = not populated (option).

RFM69 option





CC1101 module



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: SPI level shifter / radio modules/
File: DNP_07_Radio_SPI.kicad_sch

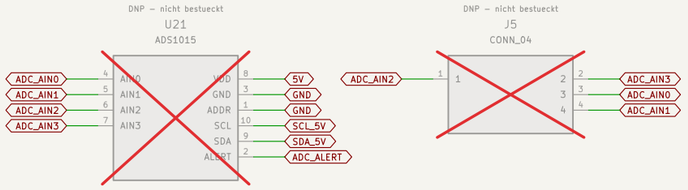
Title: SHPI.zero proto / DNP: Radio SPI

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 16/23

DNP / Options: I2C expansion / ADC / DAC / RTC

DNP = not populated (option).

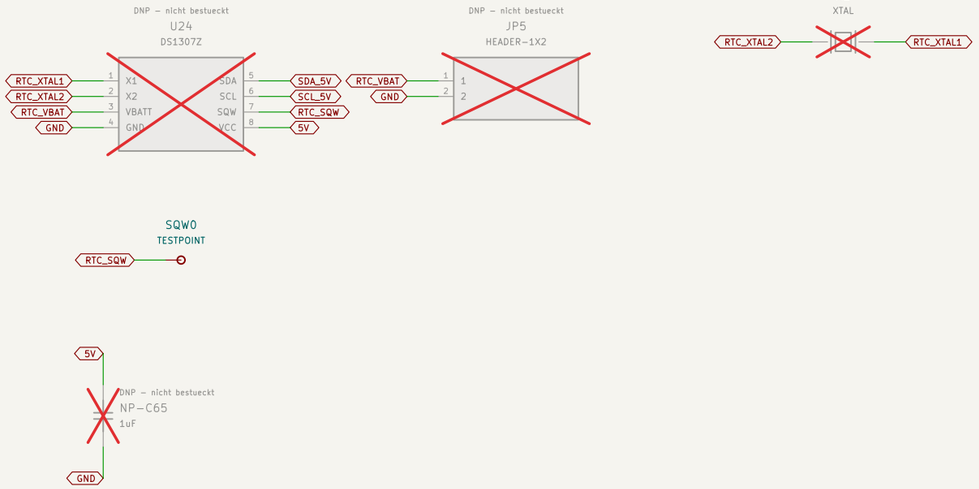
ADS1015 ADC



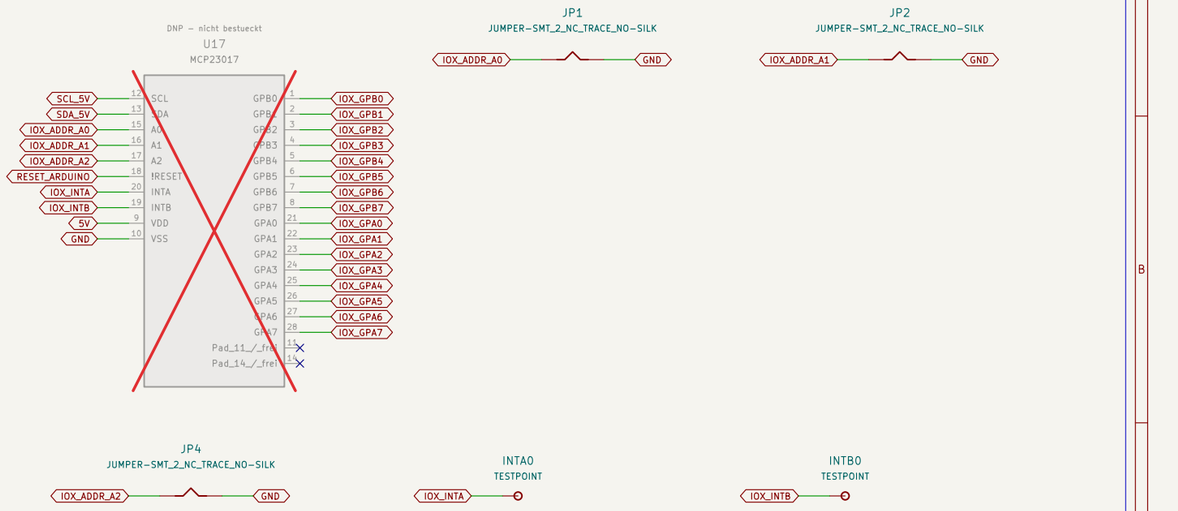
MCP4725 DAC



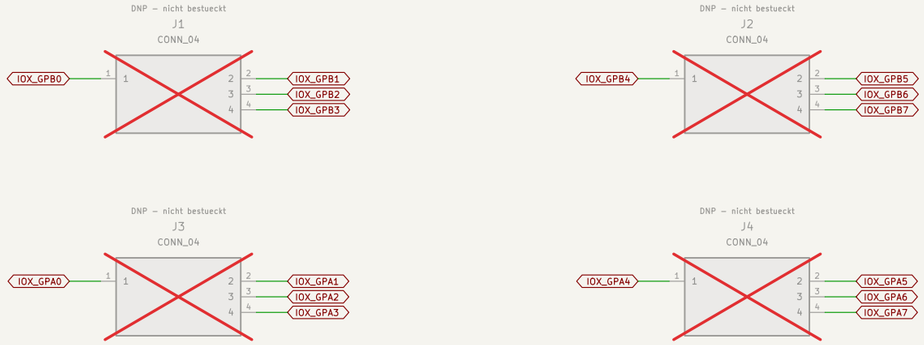
DS1307 RTC



MCP23017 GPIO expander



GPIO connectors J1–J4



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: I2C expansion / ADC / DAC / RTC/
File: DNP_09_I2C_Expansion.kicad_sch

Title: SHPI.zero proto / DNP: I2C Expansion

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 17/23

DNP / Options: I2C level shifter / climate / air quality / light

DNP = not populated (option).

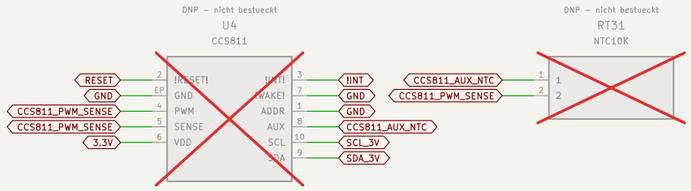
BMP/BME280 / BME680 options

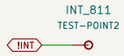


SHT31 / HTU21D

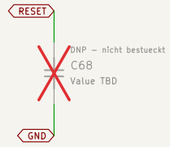


CCS811 / compensation





BH1751 / sensor reset



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: I2C level shifter / climate / air quality / light/
File: DNP_10_I2C_Climate.kicad_sch

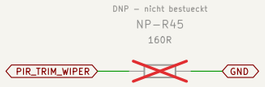
Title: SHPI.zero proto / DNP: I2C Climate

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 18/23

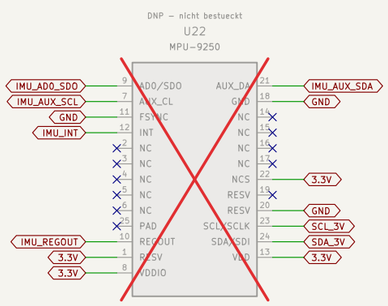
DNP / Options: Motion / temperature / thermal imaging

DNP = not populated (option).

PIR S16-L221D / TM1



MPU-9250 IMU

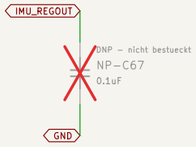


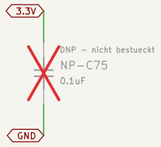








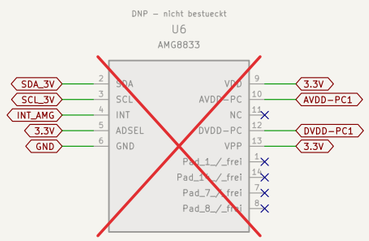




MLX90615 temperature



AMG8833 thermal imaging





SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: Motion / temperature / thermal imaging/
File: DNP_11_Motion_Thermal.kicad_sch

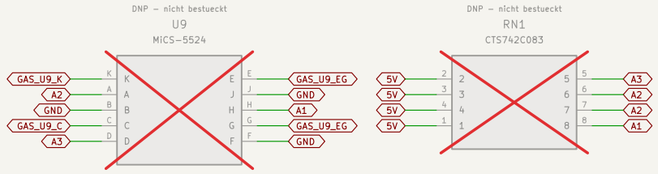
Title: SHPI.zero proto / DNP: Motion Thermal

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 19/23

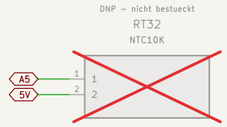
DNP / Options: Analog gas sensors / NTC

DNP = not populated (option).

MICS-5524 / heating resistors



NTC / current input



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: Analog gas sensors / NTC/
File: DNP_12_Gas_Analog.kicad_sch

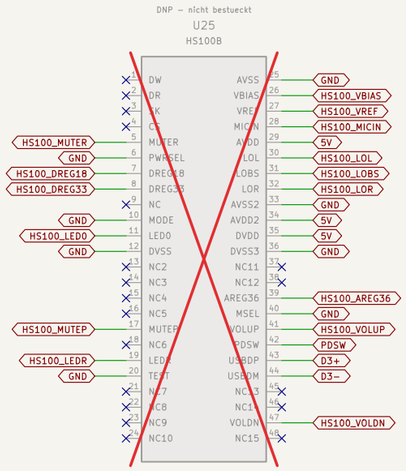
Title: SHPI.zero proto / DNP: Gas Analog

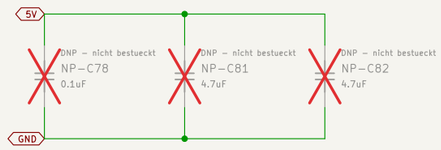
Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 20/23

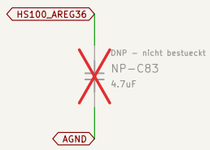
DNP / Options: USB audio / HS100B

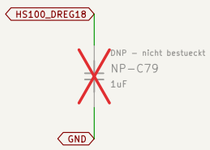
DNP = not populated (option).

HS100B / USB



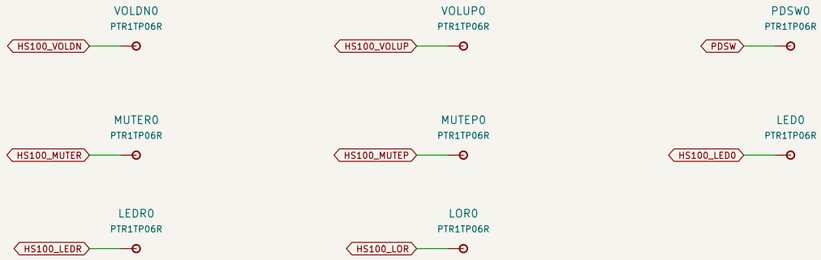




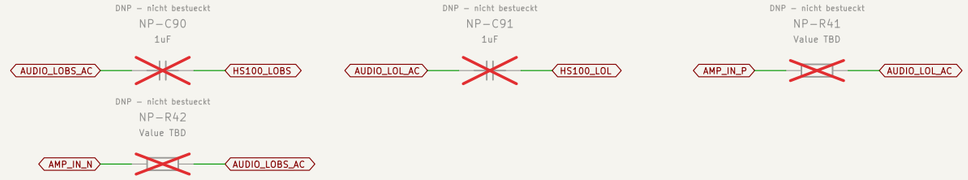




Control/status pads



Audio output coupling



SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: USB audio / HS100B/
File: DNP_13_USB_Audio_Codec.kicad_sch

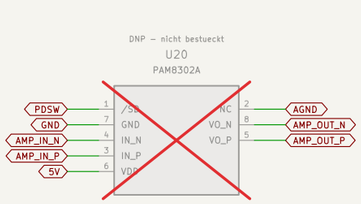
Title: SHPI.zero proto / DNP: USB Audio Codec

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 21/23

DNP / Options: Audio power amplifier / microphone

DNP = not populated (option).

PAM8302A output stage

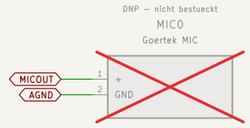








Microphone / bias / input filter

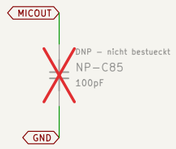


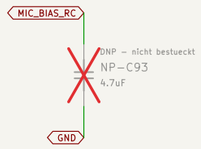




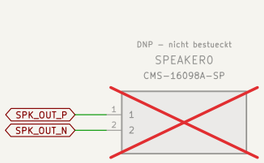






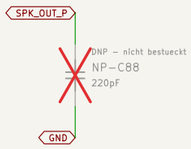


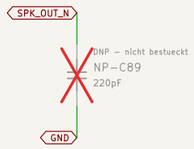
Speaker / output filter











SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: Audio power amplifier / microphone/
File: DNP_14_Audio_Analog.kicad_sch

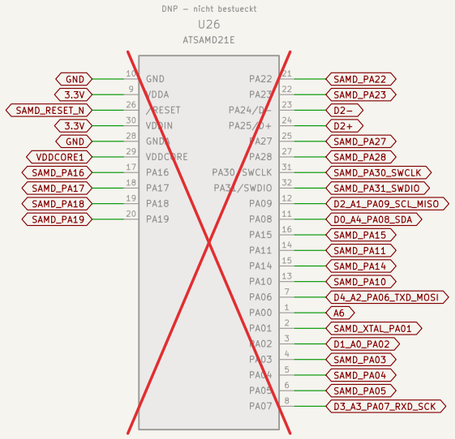
Title: SHPI.zero proto / DNP: Audio Analog

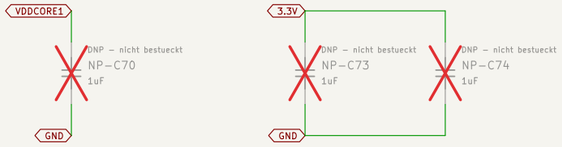
Size: A3	Date: 2026–11–07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 22/23

DNP / Options: SAMD21 / expansion / reference options

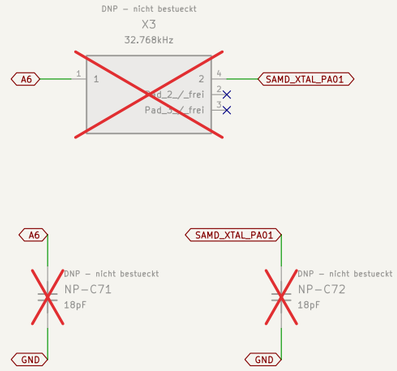
DNP = not populated (option).

SAMD21E supply / core

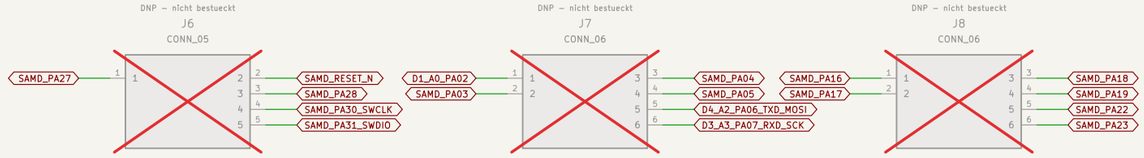


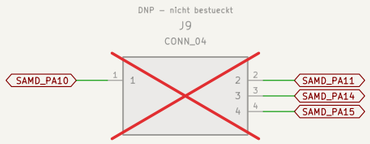


SAMD21 32 kHz clock



SAMD21 expansion/programming connector

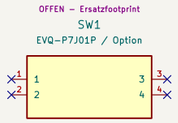








Unwired options





SHPI.zero prototype | Functional schematic

SHPI

Sheet: /DNP / Options: SAMD21 / expansion / reference options/
File: DNP_15_SAMD21.kicad_sch

Title: SHPI.zero proto / DNP: SAMD21

Size: A3	Date: 2026-11-07	**Rev: R1**
KiCad E.D.A. 10.0.6		Id: 23/23