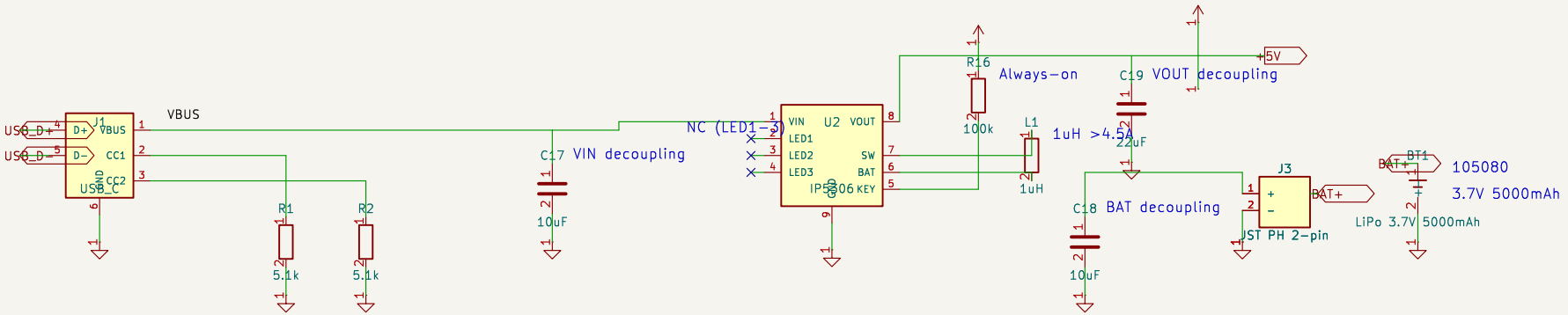
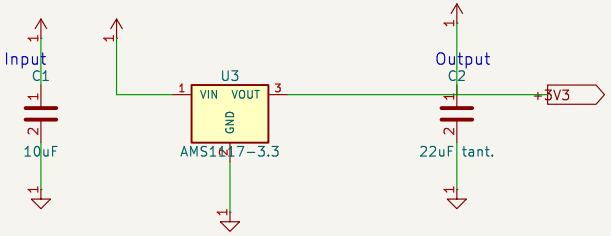
POWER SUPPLY

USB-C -> IP5306 SOP-8 (charge + boost) -> AMS1117-3.3 -> 3.3V rail



VOLTAGE REGULATOR

5V -> AMS1117-3.3 -> 3.3V (800mA max)



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ESP32 Emu Turbo - Handheld Retro Console

Sheet: /
File: 01-power-supply.kicad_sch

Title: Power Supply

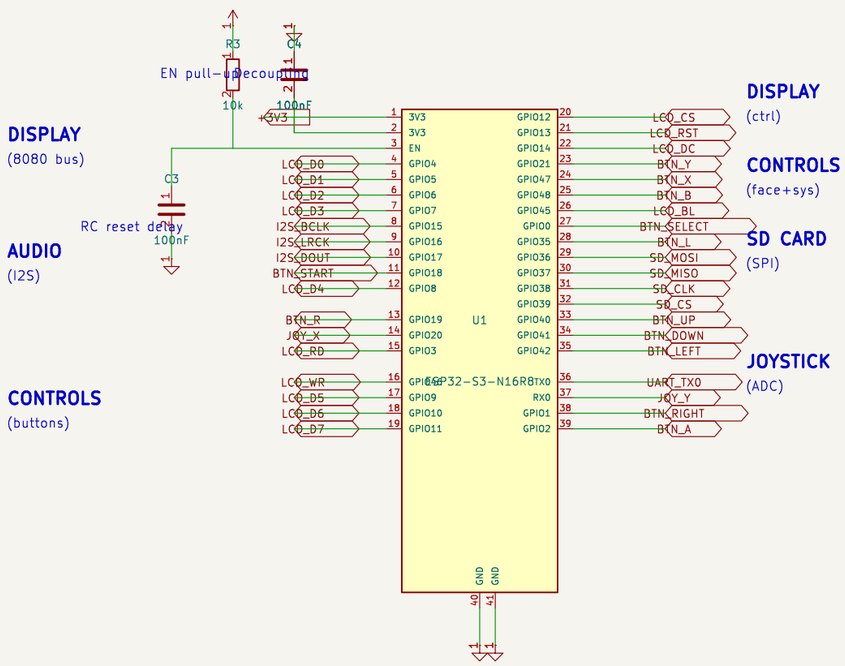
Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.7		Id: 1/1

Design Notes:

- IP5306 eSOP-8: integrated charger + synchronous boost (no ext. Schottky)
- 1uH inductor: BAT -> L1 -> SW (>4.5A saturation, shielded)

MCU — ESP32-S3-WROOM-1 N16R8

Dual-core LX7 @ 240MHz, 16MB Flash, 8MB PSRAM



GPIO ASSIGNMENT TABLE

Display (8080 parallel):

GPIO4–11 = D0–D7 (8-bit data bus)
GPIO12=CS GPIO13=RST GPIO14=DC
GPIO46=WR GPIO3=RD GPIO45=BL

Audio (I2S):

GPIO15=BCLK GPIO16=LRCK GPIO17=DOUT

SD Card (SPI):

GPIO36=MOSI GPIO37=MISO GPIO38=CLK GPIO3

Controls (active low, 10k pull-up):

D-pad: GPIO40=UP 41=DOWN 42=LEFT 1=RIGHT
Face: GPIO2=A 48=B 47=X 21=Y
Sys: GPIO18=START 0=SELECT 35=L 19=R

Joystick (ADC, optional):

GPIO20=X_AXIS (ADC2_CH9)
GPIO44/RX0=Y_AXIS (ADC2_CH7)

Reserved (do not use):

GPIO26–32 = Octal PSRAM (internal)
GPIO43 = TX0 (debug UART output)

Generated by scripts/generate_schematics
ESP32 Emu Turbo — Handheld Retro Console

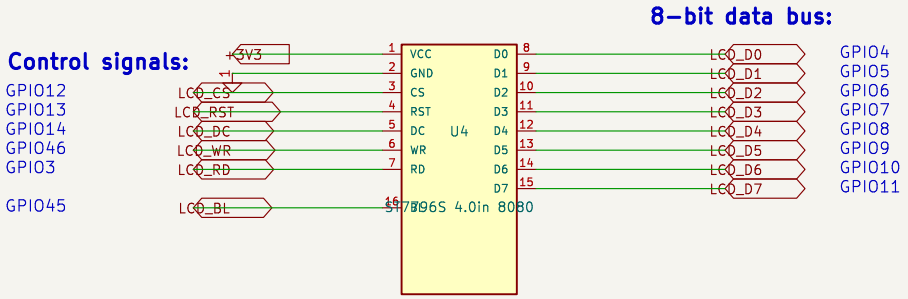
Sheet: /
File: 02-mcu.kicad_sch

Title: MCU — ESP32-S3-WROOM-1 N16R8

Size: A3 | Date: | **Rev:**
KiCad E.D.A. 9.0.7 | Id: 2/1

DISPLAY – ST7796S 4.0in 320x480

8–bit 8080 parallel interface (mandatory for SNES emulation speed)



Design Notes:

- 8080 parallel: 1 pixel (16–bit RGB565) = 2 bus cycles
- SPI alternative: 16 clock cycles per pixel (too slow for 60fps SNES)
- GPIO4–11 form contiguous 8–bit bus for efficient register–level DMA
- WR strobes data on rising edge, RD directly from GPIO3

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ESP32 Emu Turbo – Handheld Retro Console

Sheet: /
File: 03–display.kicad_sch

Title: Display – ST7796S 4.0in 8080 Parallel

Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.7		Id: 3/1

AUDIO OUTPUT

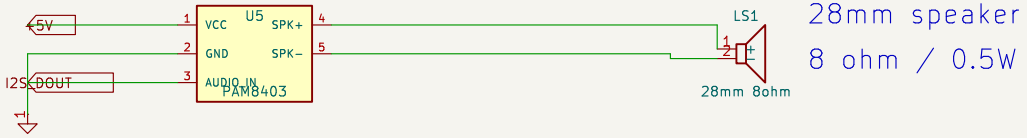
I2S DAC -> PAM8403 Class-D Amplifier -> 28mm 8ohm Speaker

I2S Bus (directly from ESP32-S3):

I2S_BCLK — GPIO15 — Bit Clock (1.411 MHz @ 44.1kHz)

I2S_LRCK — GPIO16 — L/R Word Select (44.1kHz)

I2S_DOUT — GPIO17 — Serial Data Out -> PAM8403



Design Notes:

- PAM8403: filterless Class-D stereo amplifier (3W per channel max)
- Only one channel used for mono audio
- No external DAC needed: ESP32-S3 has built-in I2S with DMA
- Powered from +5V rail for max headroom (3.3V limits volume)
- DMA-driven audio streaming for low CPU overhead

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ESP32 Emu Turbo — Handheld Retro Console

Sheet: /
File: 04-audio.kicad_sch

Title: Audio — I2S -> PAM8403 -> Speaker

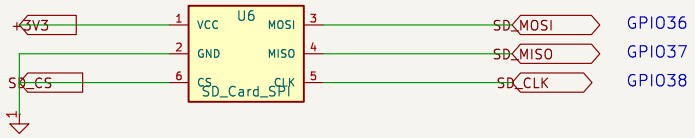
Size: A4	Date:	Rev:
KiCad E.D.A. 9.0.7		Id: 4/1

STORAGE — Micro SD Card

SPI interface for ROM storage (SNES ROMs up to 6MB)

Chip Select:
GPIO39

SPI bus:



Design Notes:

- SPI bus @ up to 40MHz (ESP32-S3 max for SD)
- SNES ROMs: 256KB to 6MB typical (HiROM/LoROM)
- FAT32 filesystem for easy ROM management via PC
- 3.3V logic: no level shifter needed (module has built-in)
- GPIO36-39 grouped for clean SPI trace routing on PCB

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ESP32 Emu Turbo — Handheld Retro Console

Sheet: /
File: 05-sd-card.kicad_sch

Title: Storage — SD Card SPI

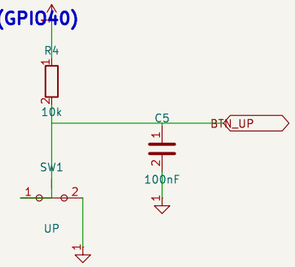
Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.7		Id: 5/1

CONTROLS — 12 Tact Switches

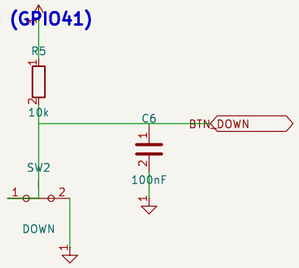
Active-low with 10k pull-up + 100nF debounce per button

D-PAD

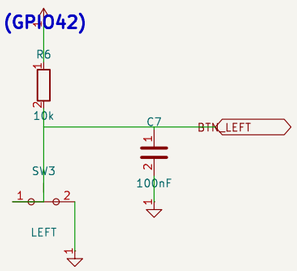
UP (GPIO40)



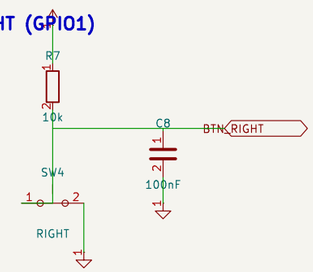
DOWN (GPIO41)



LEFT (GPIO42)

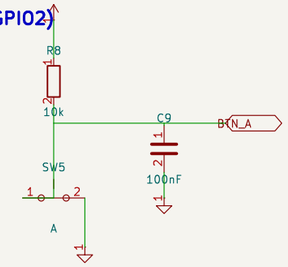


RIGHT (GPIO1)

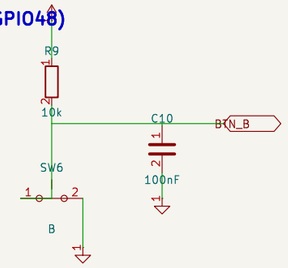


FACE BUTTONS (ABXY)

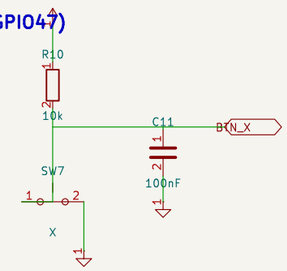
A (GPIO2)



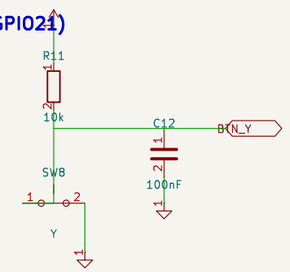
B (GPIO48)



X (GPIO47)

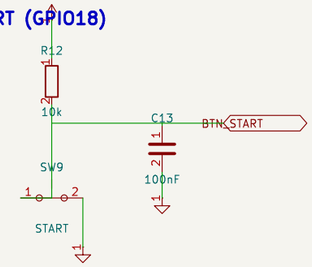


Y (GPIO21)

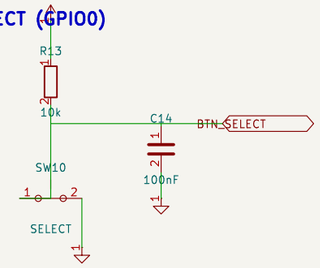


SYSTEM + SHOULDER

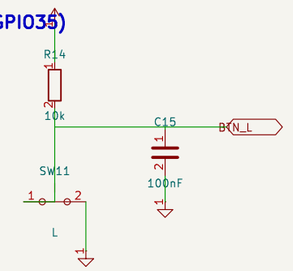
START (GPIO18)



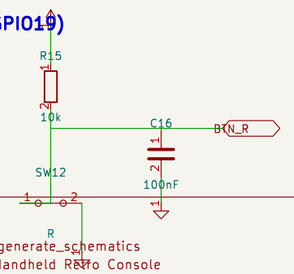
SELECT (GPIO0)



L (GPIO35)



R (GPIO19)



Generated by scripts/generate_schematics
ESP32 Emu Turbo — Handheld Retro Console

Sheet: /
File: 06-controls.kicad_sch

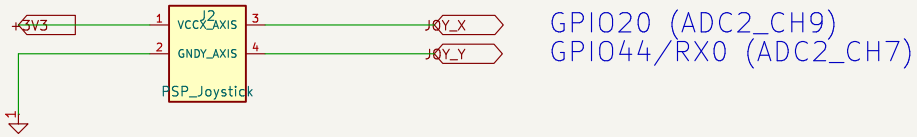
Title: Controls — 12 Buttons (SNES Layout)

Size: A3	Date:	Rev:
KiCad E.D.A. 9.0.7		Id: 6/1

BUTTON CIRCUIT (repeated 12x):

JOYSTICK — PSP Analog Stick (Optional)

2-axis analog input via ESP32-S3 ADC channels



Design Notes:

- PSP-style mini analog stick with potentiometer outputs
- X/Y outputs: 0V (min) to 3.3V (max), ~1.65V at center
- ESP32-S3 ADC2: 12-bit resolution (4096 steps per axis)
- Optional: can be omitted for D-pad-only build
- GPIO44 shares RX0 UART pin; debug input unavailable when connected
- GPIO43 (TX0) still works for debug UART output

Generated by scripts/generate_schematics
ESP32 Emu Turbo — Handheld Retro Console

Sheet: /
File: 07-joystick.kicad_sch

Title: Joystick — PSP Analog (Optional)

Size: A4	Date:	**Rev:**
KiCad E.D.A. 9.0.7		Id: 7/1