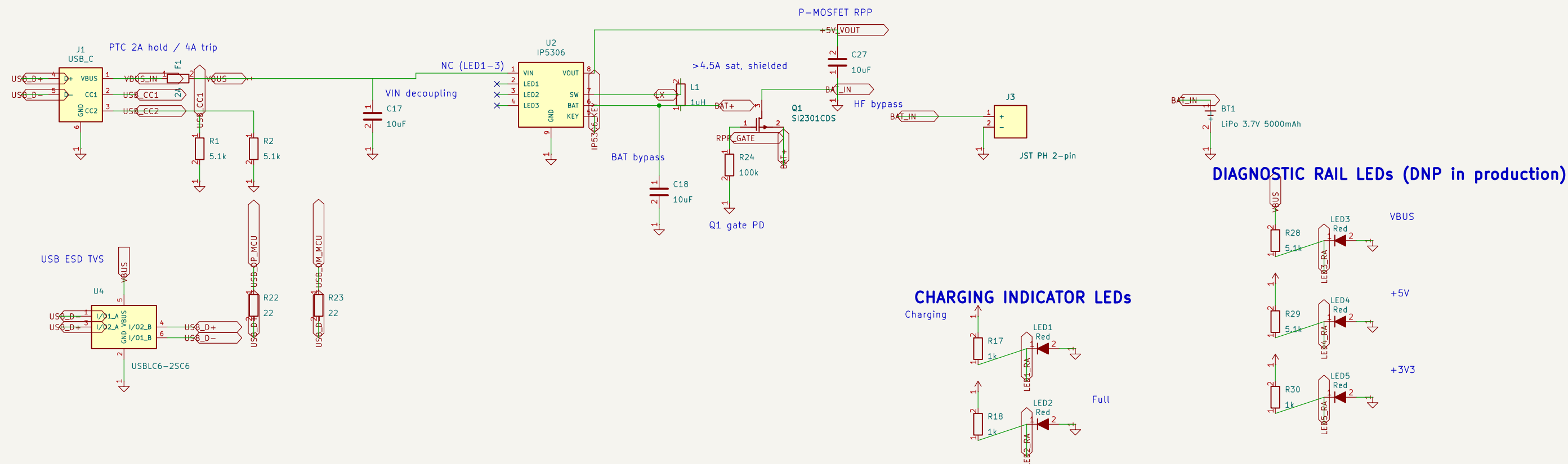


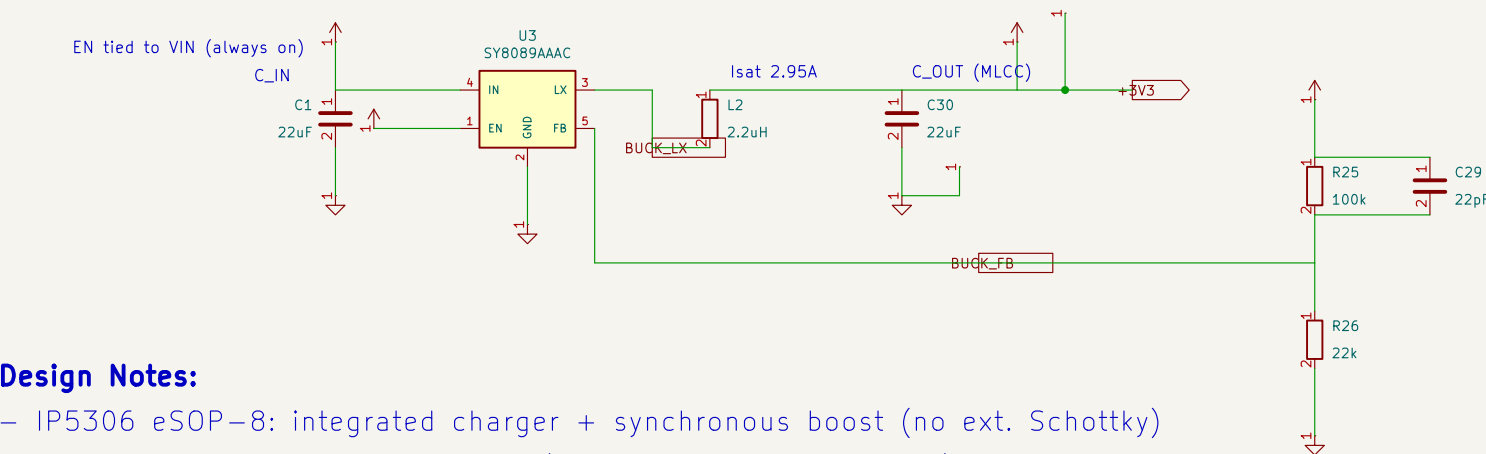
POWER SUPPLY

USB-C -> IP5306 SOP-8 (charge + boost) -> SY8089AAAC buck -> 3.3V rail



VOLTAGE REGULATOR

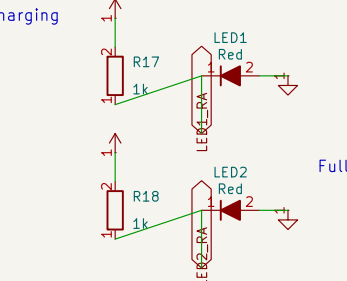
5V -> SY8089AAAC synchronous buck -> 3.327V (2A cont. / 3A peak)
Replaces AMS1117-3.3 LDO: ~90% efficiency instead of burning 1.7V x Iload (0.85W at 500mA).



Design Notes:

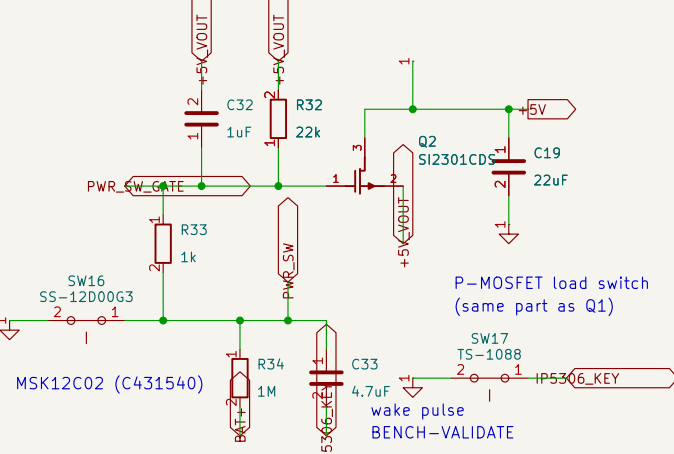
- IP5306 eSOP-8: integrated charger + synchronous boost (no ext. Schottky)
- 1uH inductor: BAT -> L1 -> SW (>4.5A saturation, shielded)
- GND via exposed pad only (must solder to ground plane)
- KEY driven by C33 wake pulse (R16 100k pull-up DELETED)
- SY8089AAAC buck: 3.327V for ESP32-S3 and peripherals (2A cont., 3A peak)
- C2 (22uF tantalum) DELETED: reversed assembly destroyed prototype #1; C30 is a non-polarized MLCC
- 5.1k CC pull-downs identify USB-C UFP (5V sink)
- Battery: LiPo 3.7V 5000mAh via JST PH connector

CHARGING INDICATOR LEDs



POWER SWITCH

SW16 -> Q2 high-side switch on the +5V load rail
IP5306 keeps charging with the console switched off



FEEDBACK DIVIDER

$V_{out} = 0.6 \times (1 + 100k/22k) = 3.327V$
C29 = datasheet feed-forward cap (load transient)

manual KEY wake (DO NOT PLACE)
fit only if the C33 pulse is short

Generated by scripts/generate_schematics ESP32 Emu Turbo - Handheld Retro Console		
Sheet: / File: 01-power-supply.kicad_sch		
Title: Power Supply		
Size: A3	Date:	Rev:
KiCad E.D.A. 10.0.5		Id: 1/1

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 (RD/BL tied +3V3 on FPC)

Audio (I2S):

GPIO15=BCLK GPIO16=LRCK GPIO17=DOUT

SD Card (SPI):

GPIO44=MOSI GPIO43=MISO GPIO38=CLK GPIO3

Controls (active low, 10k pull–up):

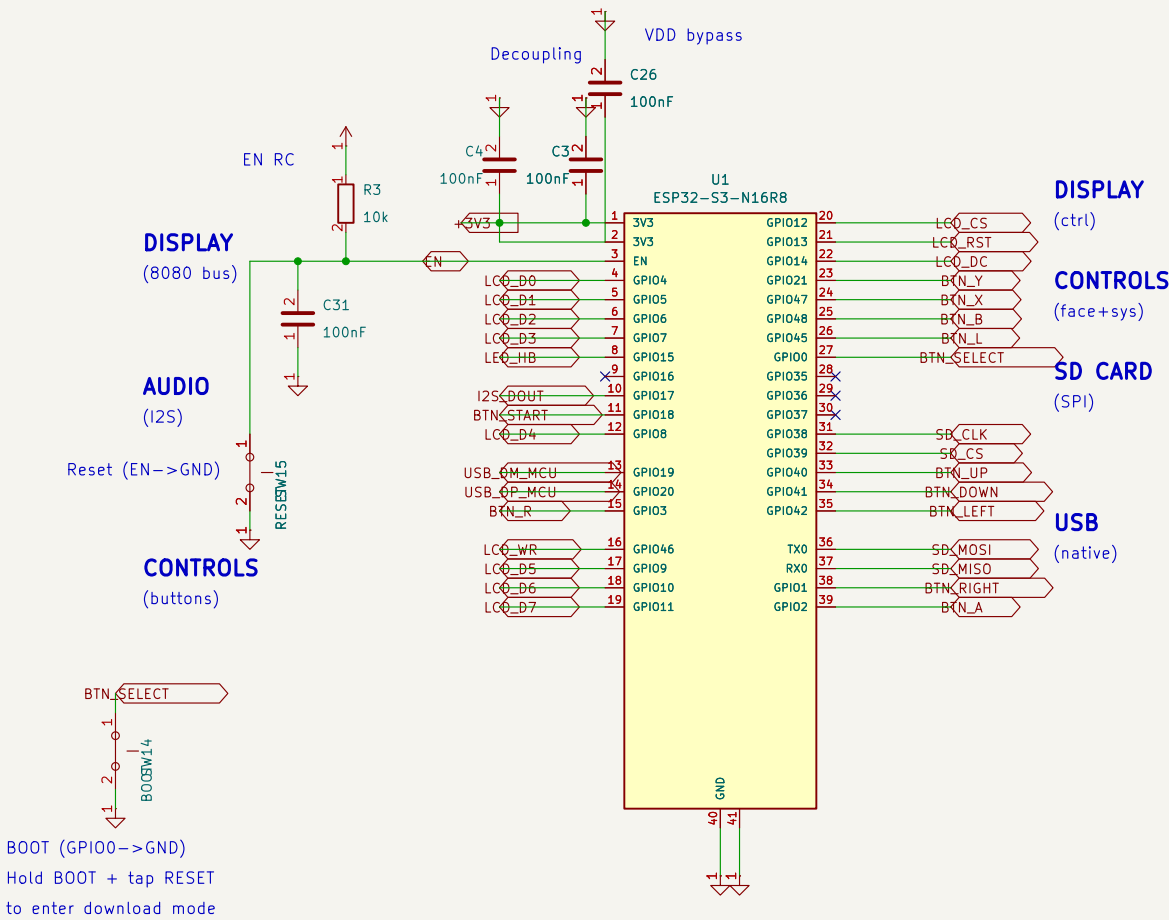
D–pad: GPIO40=UP 41=DOWN 42=LEFT 1=RIGHT
Face: GPIO2=A 48=B 47=X 21=Y
Sys: GPIO18=START 0=SELECT 45=L 3=R

USB (native, firmware flash + debug):

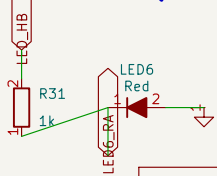
GPIO19=D– GPIO20=D+

Reserved (do not use, module–internal):

GPIO26–32 = Octal Flash (N16)
GPIO33–37 = Octal PSRAM (R8)



HEARTBEAT LED (GPIO15, DNP in production)



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. 10.0.5		Id: 2/1

DISPLAY – ILI9488 3.95in 320x480

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

Control signals:

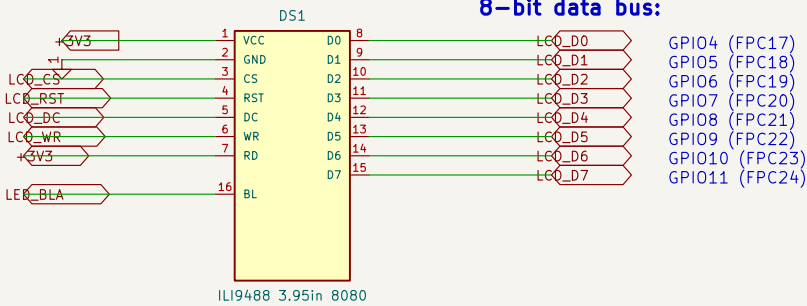
GPIO12 / FPC9
GPIO13 / FPC15
GPIO14 / FPC10
GPIO46 / FPC11
+3V3 (FPC12, R0)

BL via R27 (FPC33)



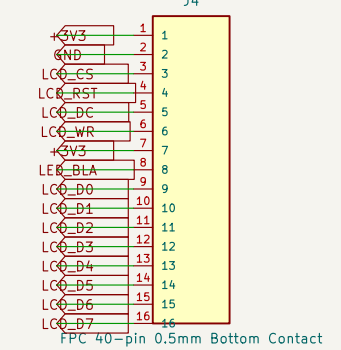
Backlight: $(5.0-3.2V)/20R = 90mA$
(family class 6-LED/90mA)

8-bit data bus:



FPC RIBBON CONNECTOR (J4)

(40P on PCB, 16 active signals shown)



ILI9488 Panel FPC-40P Pin Mapping (source: components.md):

Panel 6,7=VDDI/VDDA(+3V3) 9=CS 10=DC 11=WR 12=RD 15=RESET

Panel 17-24=DB0-DB7 33=LED-A(BL) 34-36=LED-K(GND) 38,39=IM0,IM1(+3V3) 40=IM2(GND)

Interface mode: IM2=0 IM1=1 IM0=1 = 8080 8-bit parallel

- GPIO4-11 form contiguous 8-bit bus for efficient register-level DMA
- WR strobes data on rising edge, RD tied HIGH (+3V3, write-only mode)

□ FPC PIN REVERSAL on PCB: panel pin N ↔ J4 pad (41-N).

e.g. panel pin 17 (DB0) contacts J4 pad 24. See datasheet_specs.py for the connector-side mapping.

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

Sheet: /
File: 03-display.kicad_sch

Title: Display – ILI9488 3.95in 8080 Parallel

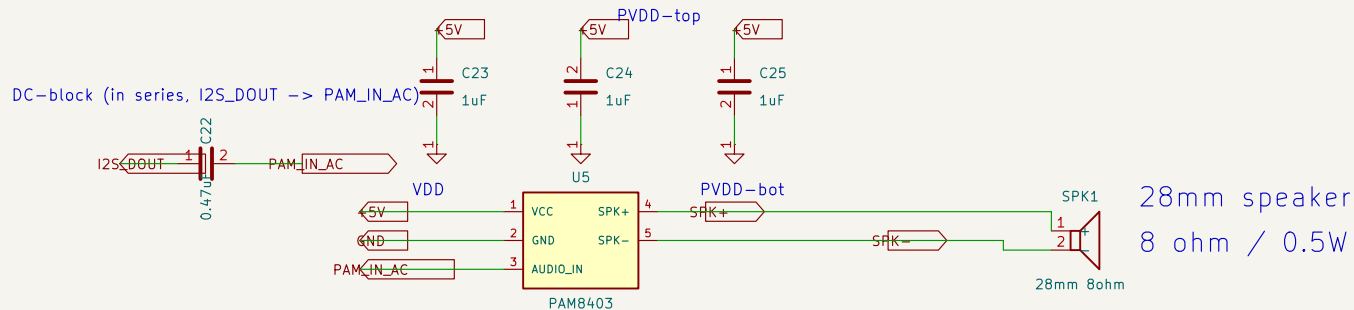
Size: A3	Date:	Rev:
KiCad E.D.A. 10.0.5		Id: 3/1

AUDIO OUTPUT

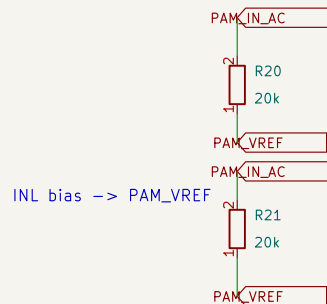
I2S DAC -> PAM8403 Class-D Amplifier -> 28mm 8ohm Speaker

I2S Bus (PDM TX mode – DOUT only):

I2S_BCLK GPIO15 – Bit Clock (UNUSED – PDM mode, v2 free)
 I2S_LRCK GPIO16 – L/R Word Select (UNUSED – PDM mode, v2 free)
 I2S_DOUT GPIO17 – PDM sigma-delta out @ 32kHz -> C22 -> PAM_IN_AC



PAM8403 Passives:



INR bias -> PAM_VREF
 R20/R21 bias the amplifier inputs to PAM_VREF (R4-HIGH-3).

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

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

Sheet: /
 File: 04-audio.kicad_sch

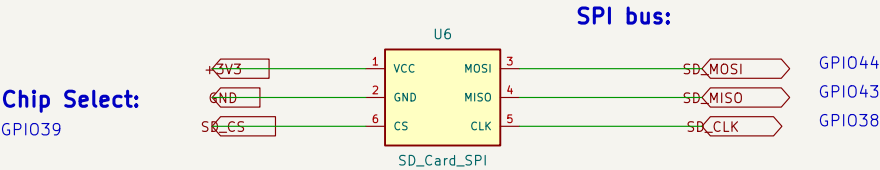
Title: Audio – I2S -> PAM8403 -> Speaker

Size: A4 Date:
 KiCad E.D.A. 10.0.5

Rev:
 Id: 4/1

STORAGE – Micro SD Card

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



Design Notes:

- SPI bus @ 20MHz (R2-MED-5: trace length ~150mm + 6 vias → 40MHz unreliable)
- 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)
- SPI pins: GPIO38/39 (CLK/CS) + GPIO43/44 (MISO/MOSI) – split across WR00M-1 left and right
- y2 TODO (R4-MED-1): add local 100nF bypass within 5 mm of U6 VCC

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

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

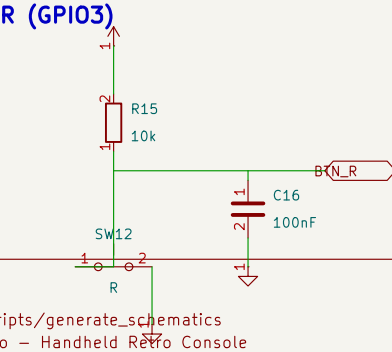
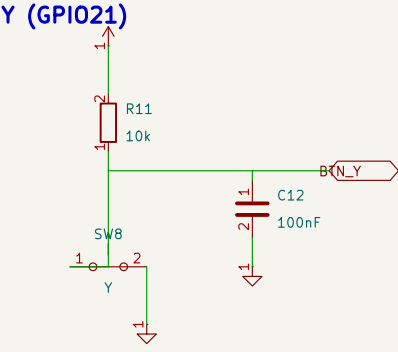
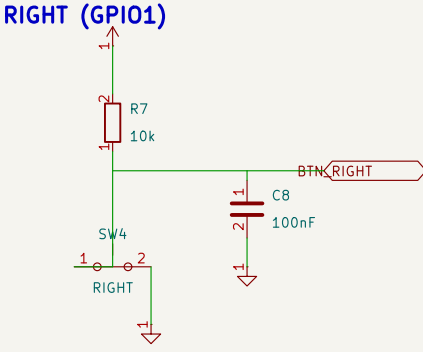
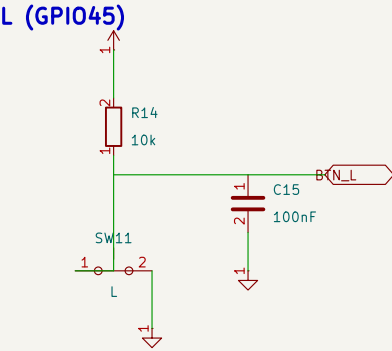
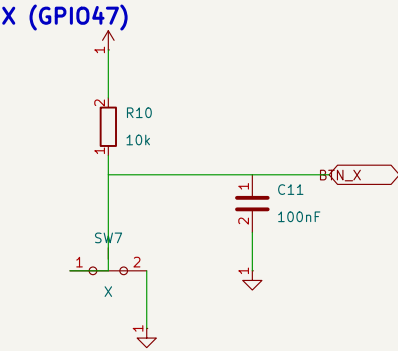
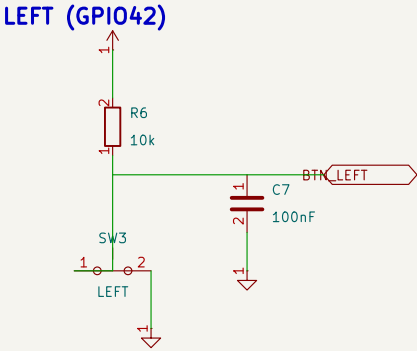
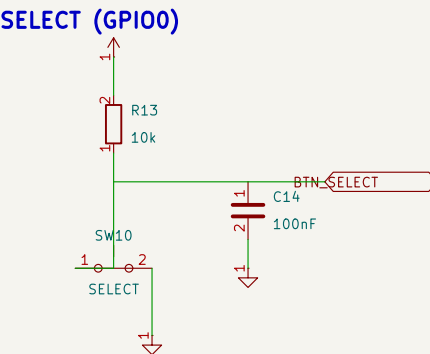
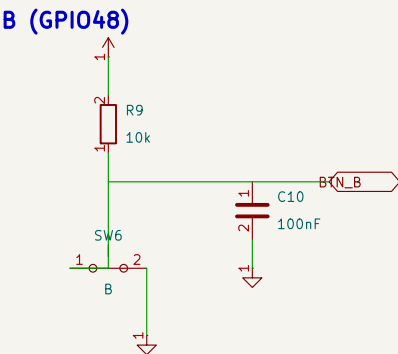
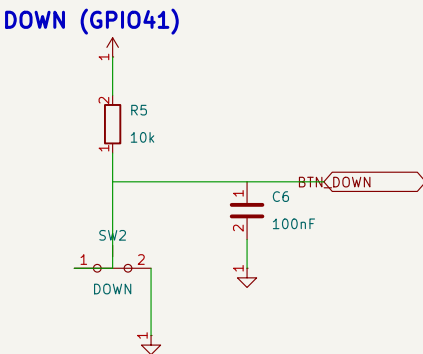
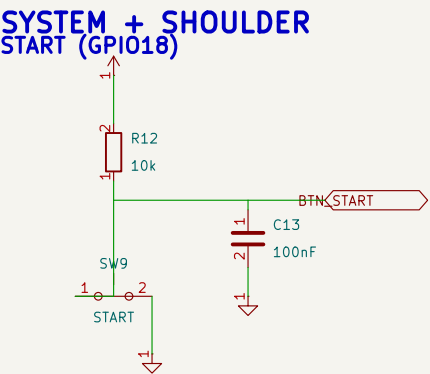
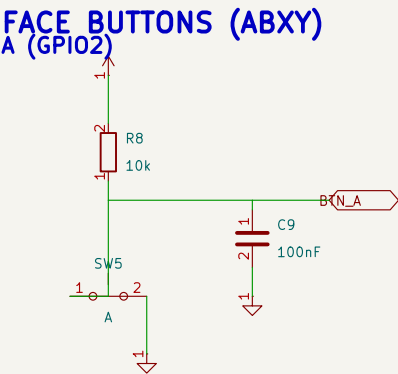
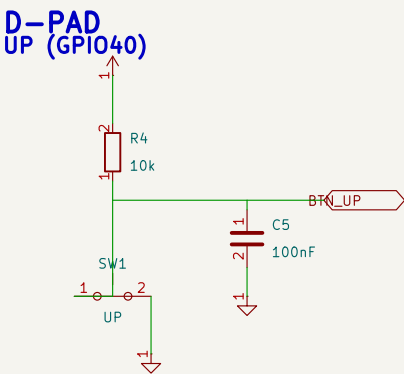
Title: Storage – SD Card SPI

Size: A4
KiCad E.D.A. 10.0.5

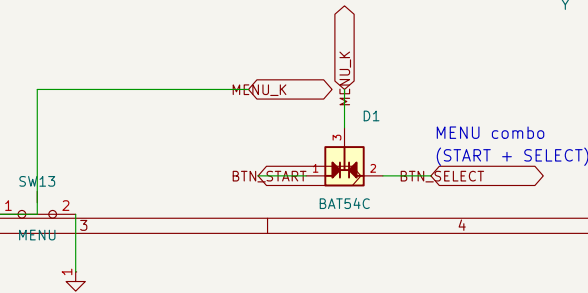
Rev:
Id: 5/1

CONTROLS – 12 Tact Switches

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



MENU BUTTON



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. 10.0.5

Id: 6/1

BUTTON CIRCUIT (repeated 12x):