

# ArcadESP: The Open-Source Retro Gaming Handheld

## Description:

The circuit is centered on an ESP32-WROVER-I microcontroller. The main power supply for the system is 3.3V.

The design integrates several key peripherals for operation. It includes a TFT screen for graphics display, managed through multiple GPIO connections of the microcontroller. For user input, the system features a series of buttons, including direction controls (up, down, left, right), action buttons (Start, Select, A, B), and menu buttons, which connect to a PCF8574 I/O port expander.

Data storage is handled through a MicroSD card slot with push-out functionality, allowing the reading and writing of information. Additionally, the circuit incorporates an auto-reset section for the microcontroller. Test points (TP1, TP2, TP3, TP4) are also included for monitoring key voltages such as V\_USB, V\_BATT and 3.3V.

## Resources:

<a href="#">USB-B</a>	Power and data connector.
<a href="#">LTC4054</a>	Integrated circuit for battery charging.
<a href="#">MIC5219 3.3v Regulator</a>	Regulates and stabilizes the voltage to 3.3V.
<a href="#">ESP32 WROVER-I</a>	The main microcontroller (the brain).
<a href="#">CH340</a>	USB to serial converter for programming.
<a href="#">BUTTONS</a>	Buttons for user interaction.
<a href="#">PCF8574 I/O Expander</a>	Expands input/output pins for the buttons.
<a href="#">TFT Display</a>	Screen for visual output.

<a href="#">Micro SD Card</a>	Module for external storage.
<a href="#">Audio DAC UDA1334ATS</a>	Converts digital audio to analog.
<a href="#">Amplifier PAM8403</a>	Amplifies the audio signal for output.
<a href="#">Jack 3.5mm</a>	Output connector for headphones or speakers.
<a href="#">LED Blue</a>	Visual status indicator light.

## Features:

**Processing Core:** ESP32-WROVER-I module with a dual-core CPU, Wi-Fi, Bluetooth, and integrated PSRAM.

**Connectivity & Power:** USB-B port for power and programming via an onboard CH340 USB-to-UART controller.

**Power Management:** Includes an LTC4054 Li-Ion battery charger and an MIC5219 LDO regulator for a stable 3.3V supply.

**Audio Subsystem:** Features an I2S Stereo DAC (UDA1334ATS), a PAM8403 Class-D amplifier, and a 3.5mm audio jack output.

**User Interface:** TFT color display for visual output, accompanied by user input buttons and a status LED.

**External Storage:** Micro SD card slot for expandable data and media storage.

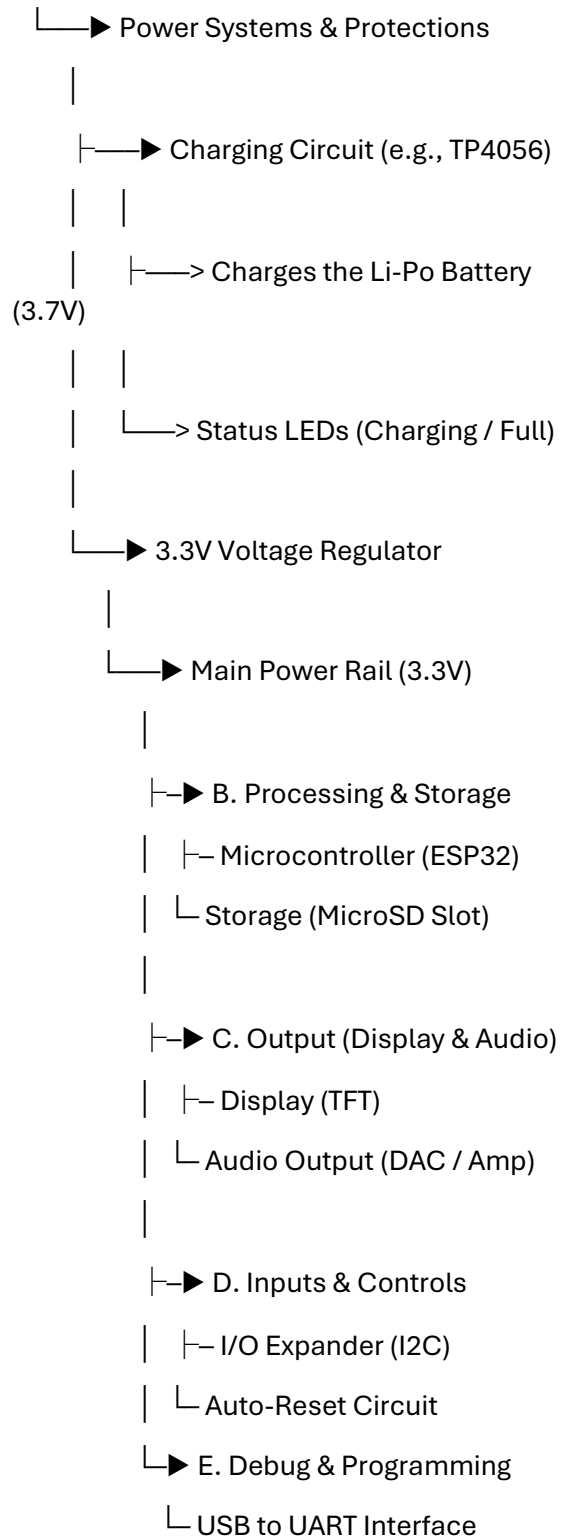
**I/O Expansion:** PCF8574 I/O expander to provide additional digital pins over the I2C bus.

## Applications:

- Retro Emulation Console (Main Application)
- Portable Media Player
- IoT Device and Control Tool
- Development and Learning Platform (All in One)

## Power Tree:

### ► Power Source (USB / Battery)



**Input Source:** Power originates from either a USB connection or a Li-Po Battery.

**Charging & Protection:** This input power feeds a charging circuit, which manages battery charging and provides a regulated output. This stage also powers the status LEDs.

**Main Regulation:** Power from the battery or charging circuit is routed to the 3.3V Voltage Regulator. This is the core of the power system, converting the variable battery voltage (typically 3.0V-4.2V) into a stable, constant 3.3V.

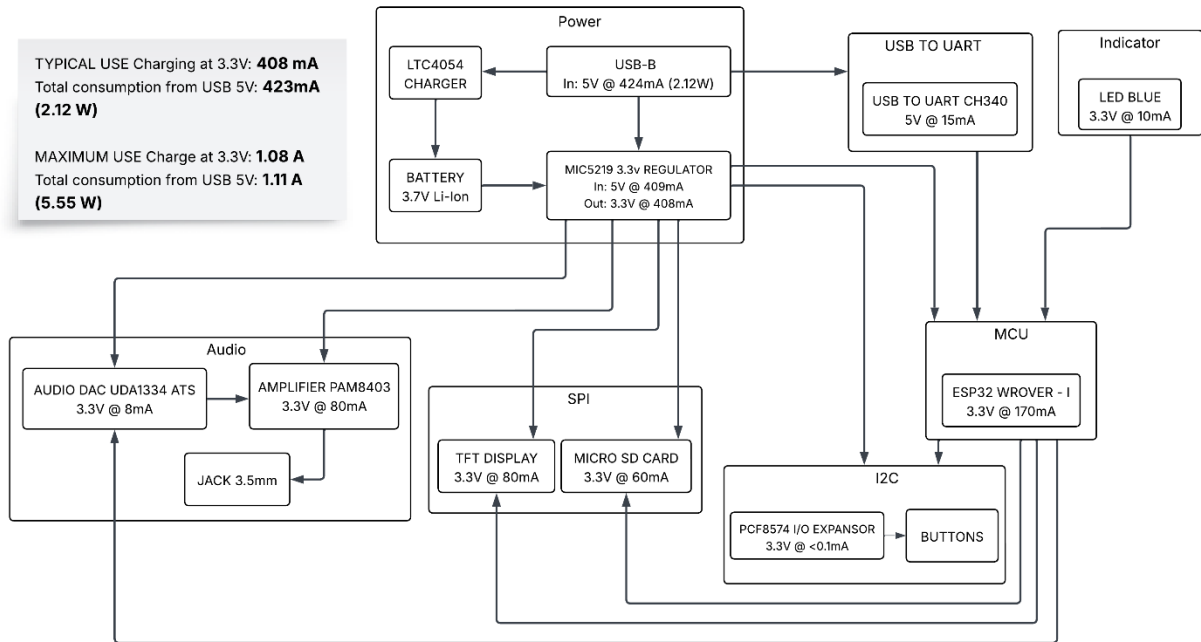
**Distribution:** The 3.3V rail distributes power to all active modules in the device: the microcontroller, display, audio circuitry, SD card slot, I/O expander, and the programming interface.

## Power Budget:

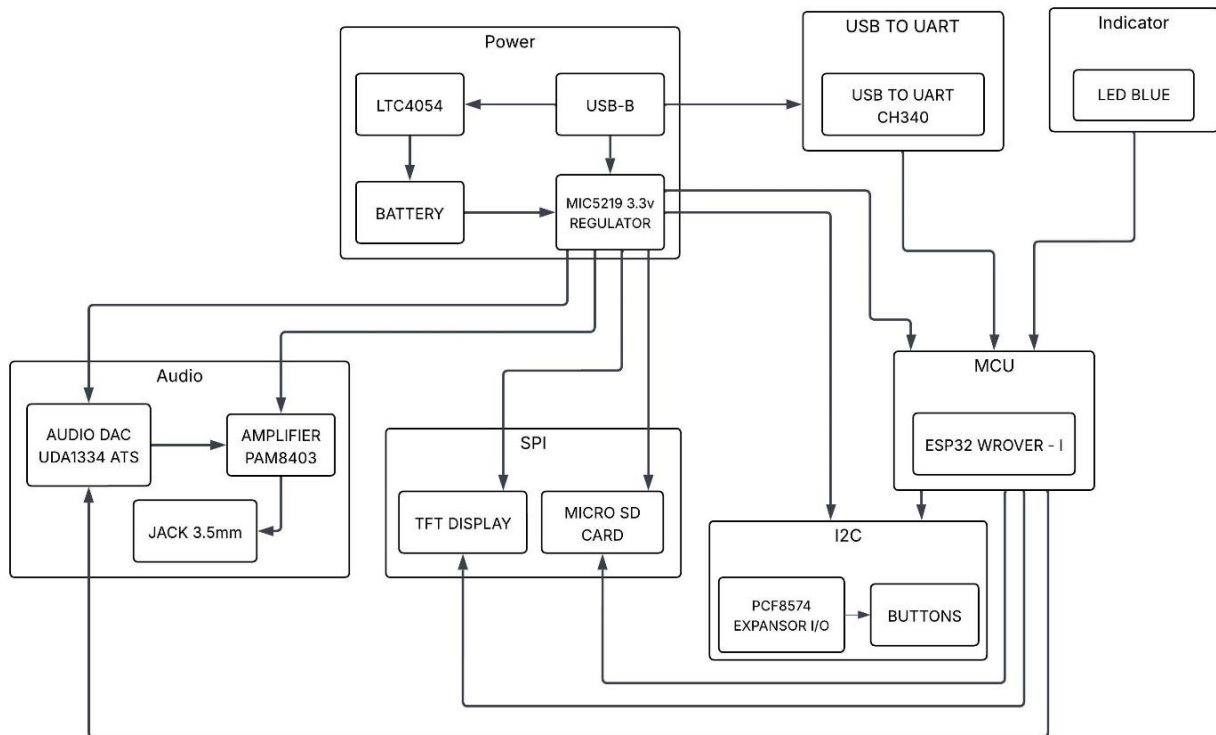
The system can be powered by a **USB** connection or a **Li-Po battery**. The input power goes through a protection and charging circuit. A central **3.3V voltage regulator** then takes this power and supplies a stable 3.3v to all the main components. These components include the **ESP32 microcontroller**, the **TFT display**, the **audio output**, the **MicroSD slot**, and the input/control circuits.

**Typical Use:** The device draws **423 mA (2.12 W)** from the 5V USB source for normal operation.

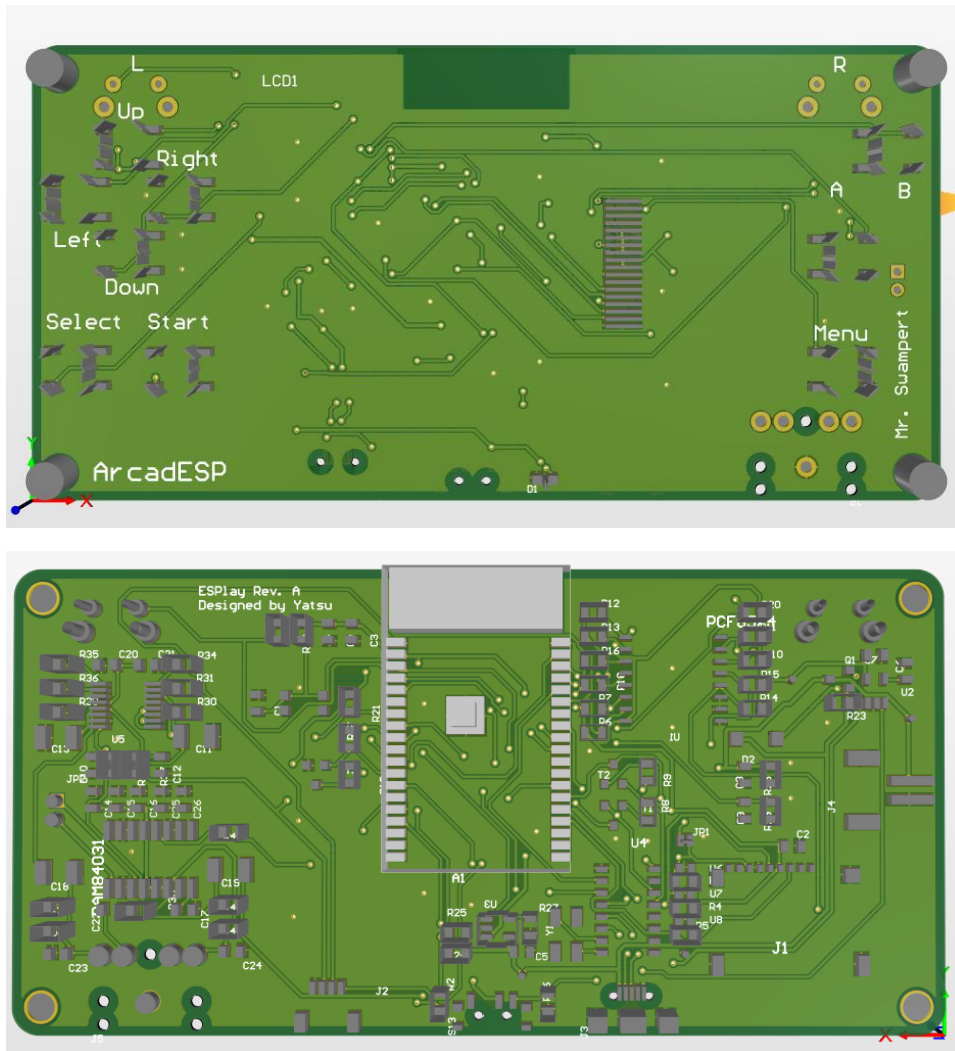
**Maximum Use:** Under heavy load (like using Wi-Fi), the draw spikes to **1.11 A (5.55 W)** from the 5V USB source.



## Block Diagram:



### 3D Model:



### Temperature:

Component	Category	Operating Temperature Range	Additional Notes
LTC4054	Battery Charger	0°C to 70°C (Guaranteed Performance)	The operating range extends from -40°C to 85°C. It has a thermal protection feature that reduces charging current if the internal temperature exceeds 120°C.
MIC5219	Voltage Regulator	-40°C to 125°C	This 3.3V regulator has a wide operating range, suitable for various environmental conditions.

ESP32 WROVER-I	MCU	-40°C to 85°C	Most ESP32-WROVER models operate in this range, making them robust for embedded applications.
PAM8403	Audio Amplifier	-40°C to 85°C	Includes over-temperature protection that shuts down the device if the internal temperature reaches 140°C.
CH340	USB to UART	-40°C to 85°C	This is the standard range for most variants of this converter chip.
PCF8574	I/O Expander	-40°C to 85°C	This component for input/output port expansion operates in a standard industrial range.
UDA1334A	Audio DAC	-20°C to 85°C	The digital-to-analog audio converter has a slightly more restricted operating range at the lower end compared to other components.
TFT Display	Display	Generally, 0°C to 50°C (Typical)	Exact ranges can vary depending on the manufacturer, but this is a common range for consumer TFT displays. Operation outside this range can affect visibility and lifespan.
Micro SD Card	Storage	-25°C to 85°C (Typical for Industrial Grade)	Consumer-grade cards may have a more limited range (e.g., 0°C to 70°C). The exact range depends on the specification of the card used.
Blue LED	Indicator	-40°C to 85°C (Typical)	Light-emitting diodes (LEDs) typically have a very wide operating range.

## References:

Pebri, "GitHub - pebri86/esplay\_micro\_hardware: Micro version of esplay hardware, ESP32 based gaming console," *GitHub*. [https://github.com/pebri86/esplay\\_micro\\_hardware](https://github.com/pebri86/esplay_micro_hardware)

"ESPlay Micro V2," *Handheld ESP32 Game Console | Makerfabs*. <https://www.makerfabs.com/esplay-micro-v2.html>

## Link to the repository where the files are hosted:

<https://github.com/MrSwampert/Portable-Gaming-Console-with-ESP32>