PICO AMBIENT BOX - BUILD GUIDE

Version 1.0 - December 2025

OVERVIEW

Ambient sound mixer with 3 simultaneous tracks, real-time filtering, and lo-fi 11kHz character.

Features:

- 3 tracks playing simultaneously (Insects, Nature, Pads)
- 16 sounds total (4 insects, 7 nature, 5 pads)
- Per-track low-pass filter
- Global pitch control (0.5x to 2x)
- Global volume control
- Lo-fi 11kHz for organic glitch texture

BILL OF MATERIALS (BOM)

Main Components:

Component	Specs	Quantity
Raspberry Pi Pico	RP2040	1
Micro SD Card Module	SPI	1
PCM5102A I2S DAC	Breakout board	1
PAM8403 Amplifier	2×3W stereo	1
Micro SD Card	8GB+ (with sounds)	1
Speaker	8Ω 5-10W	1

Controls:

Component	Specs	Quantity
Rotary Encoder	With switch	1

Potentiometers	B50K linear	2
Push Button	Momentary SPST	1

Indicators:

Component	Specs	Quantity
LEDs	3mm or 5mm	3
Resistors	220Ω ¼W	3

Optional:

Component	Purpose	Quantity
Audio Jack	3.5mm stereo	1
Power Switch	SPST	1
USB Cable	Power	1

PINOUT DIAGRAM

RASPBERRY PI PICO CONNECTIONS:

SD CARD (SPI):
CS → GP17
SCK → GP18
MOSI → GP19
MISO → GP16
VCC → 3.3V
GND → GND

PCM5102A I2S DAC:
DIN → GP9
BCK → GP10
LCK → GP11
VIN → 3.3V
AGND → GND
GND → GND

Configuration pins:
SCK → GND
FMT → GND
XSMT → 3.3V (CRITICAL - unmute!)

POTENTIOMETERS:
POT 1 (Pitch): wiper → GP26, outer → 3.3V & GND
POT 2 (Filter): wiper → GP27, outer → 3.3V & GND

ROTARY ENCODER:
CLK (A) → GP3
DT (B) → GP2
SW → GP4
GND → GND

TRACK BUTTON:
One side → GP5
Other → GND

LEDs (with 220Ω resistors):
LED 1 → GP20 → 220Ω → GND
LED 2 → GP21 → 220Ω → GND
LED 3 → GP22 → 220Ω → GND

PAM8403 AMPLIFIER:
VCC → VBUS (5V - pin 40)
GND → GND
L IN → PCM5102A LOUT
R IN → PCM5102A ROUT
L+ → Speaker +
L- → Speaker -

CRITICAL NOTES

⚠️ **MUST DO:**

- PCM5102A XSMT → 3.3V (or no sound!)
- PAM8403 VCC → 5V (VBUS), NOT 3.3V
- Connect ALL ground pins together
- PCM5102A has 3 GND pins - connect all!

SOUND FILES

Create these files on SD card (11025Hz, 16-bit, mono WAV):

/insect_antnest.wav
/insect_ants.wav
/insect_cigales.wav
/insect_crickets.wav
/nature_birds.wav
/nature_birds2.wav
/nature_cal.wav
/nature_manybirds.wav
/nature_seaside.wav
/nature_stream.wav
/nature_thunder.wav
/pad_aquab.wav
/pad_fluty.wav
/pad_man.wav
/pad_myst.wav
/pad_pady.wav

To convert in Audacity/Ableton:

- Export → WAV (Microsoft) signed 16-bit PCM
- Sample rate: 11025 Hz
- Channels: 1 (Mono)

ARDUINO SETUP

1. **Install Arduino IDE** (1.8.19 or 2.x)
2. **Add RP2040 board support:**
    - File → Preferences
    - Additional Board Manager URLs: `https://github.com/earlephilhower/arduino-pico/releases/download/global/package_rp2040_index.json`
    - Tools → Board → Boards Manager
    - Search "pico" → Install "Raspberry Pi Pico/RP2040" by Earle F. Philhower
3. **Install libraries:**
    - Sketch → Include Library → Manage Libraries
    - Install: "Rotary" by Ben Buxton
4. **Board settings:**
    - Board: "Raspberry Pi Pico"
    - USB Stack: "Pico SDK"
    - Flash Size: "2MB (Sketch: 1MB, FS: 1MB)"
5. **Upload code:**
    - Download code from GitHub
    - Open in Arduino IDE

    - Connect Pico via USB
    - Click Upload

CONTROLS

ROTARY ENCODER:

- Turn → Navigate sounds (cycles through 16 files)
- Press + Turn → Adjust global volume (0-20%)

TRACK BUTTON:

- Press → Cycle through tracks (Insects → Nature → Pads)
- LEDs indicate active track

POT 1 (TUNE):

- Adjust global pitch (0.5x to 2x speed)
- Affects all 3 tracks simultaneously

POT 2 (FILTER):

- Adjust low-pass filter for active track
- Each track remembers its filter setting
- Move pot to "catch" value when switching tracks

TROUBLESHOOTING

No sound:

- Check PCM5102A XSMT → 3.3V
- Check PAM8403 VCC → 5V (not 3.3V)
- Verify all GND connections
- Check Serial Monitor for errors

Glitchy/distorted:

- Reduce global volume
- Check power supply (use good USB cable)
- Verify SD card formatted as FAT32

Encoder not working:

- Swap GP2 and GP3 if direction reversed
- Check GND connection

- Verify rotary library installed

Upload pop/crack:

- Normal due to I2S initialization
- Add capacitor 100µF on speaker if annoying