LUMA MUSIC

Jingle Bells and 6 lights
USB tabletop prototype · 2026-11-03

Rev C: red, green and yellow pairs are controlled independently. The two LEDs in each pair operate together. Chorus: 32 seconds, then 4 seconds of silence, repeating. This is not RGB or six individually addressable channels.

This is a design, not a tested product. Actual electronics have not been validated. Internal batteries, mounts and cable entry have not yet been designed. Assemble and test on a bench first.

Parts list

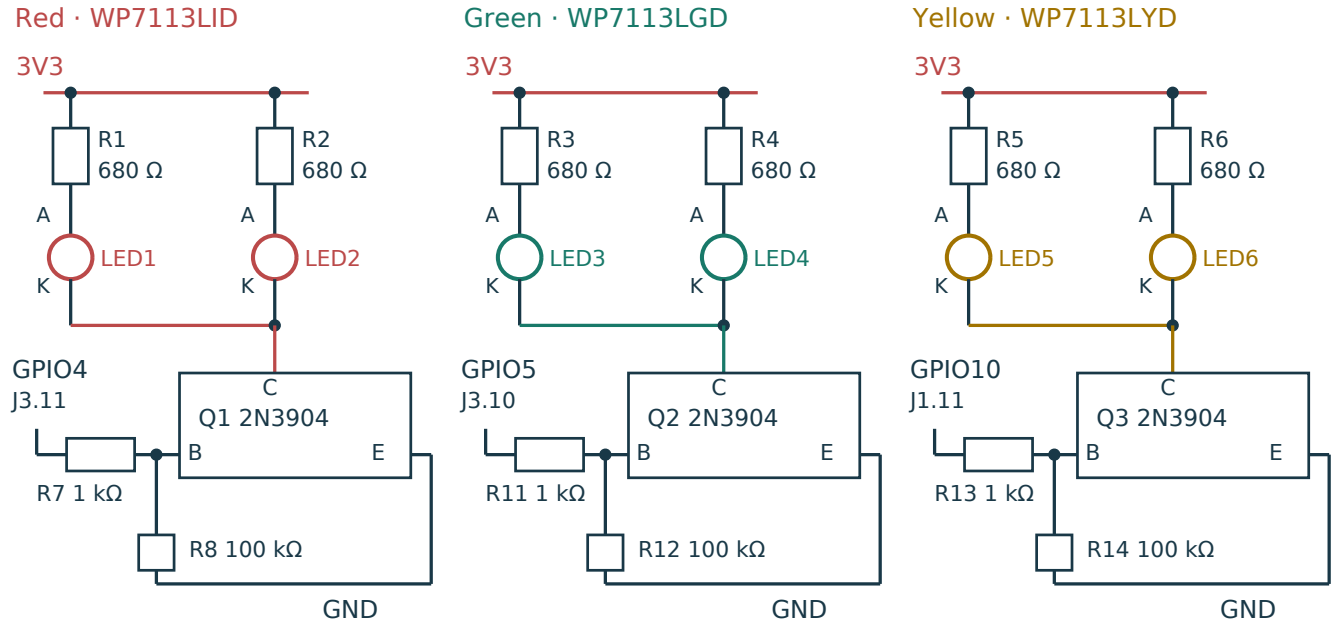
Qty	Part
1	Official ESP32-C3-DevKitM-1. Not a bare module or an arbitrary SuperMini.
2 + 2 + 2	Kingbright WP7113LID (red), WP7113LGD (green), WP7113LYD (yellow), 5 mm low-current.
6	R1-R6: 680 ohm, ±5%, ≥0.125 W. One resistor per LED.
3	Q1-Q3: onsemi 2N3904BU, NPN TO-92. Datasheet pins: 1=E, 2=B, 3=C.
4	R7, R9, R11, R13: 1 kohm each, ±5%, ≥0.125 W.
3 + 1	R8, R12, R14: 100 kohm; R10: 1 Mohm, ±5%.
1	BZ1: Murata PKM13EPYH4000-A0, passive piezo, 5.5 nF ±30%, Ø12.6 mm.
1	C1: 100 nF ±10%, non-polar, ≥16 V, preferably film.
1	C2: 100 nF ceramic, ≥10 V, between 3V3 and GND near the switches.
-	USB data cable, working 5 V ≥1 A supply, insulated wire, heat-shrink tubing, prototyping board and insulating mounts.

Nothing has been purchased. Murata announced this family’s EOL for 2027-09-30; the part is selected for a prototype, not long-term production supply.

1. Wiring connections

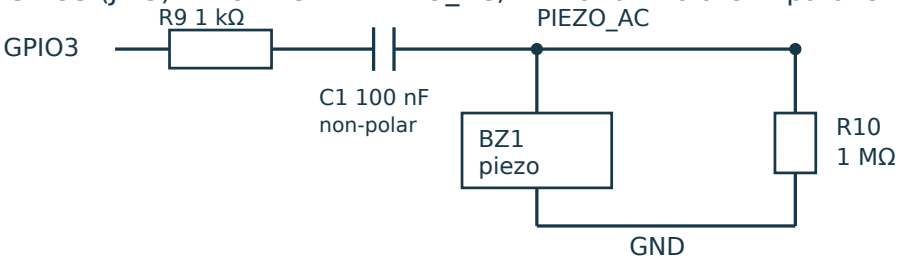
U1 · ESP32-C3-DevKitM-1 · Rev C

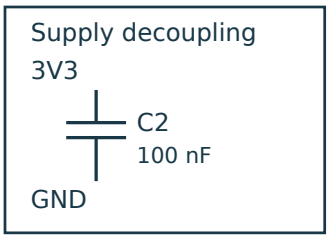
Micro-USB power only. Common rails: 3V3 and GND.



Do NOT join cathodes of different colors. C, B, E are electrical terminals.

GPIO3 (J1.5) → R9 → C1 → PIEZO_AC; BZ1 and R10 are in parallel.





Q1-Q3: onsemi 2N3904BU, 1=E, 2=B, 3=C. Check datasheet, not outline.

Circuit schematic: schematic/LUMA_Music_Schematic_RevC.pdf. This illustration shows wiring connections; check physical Q1-Q3 pin numbers against the datasheet. **C2 100 nF connects 3V3 to GND near the switches**, shown at lower right. The board, switches and piezo share ground.

A = LED anode; **K** = cathode. Each LED has its own 680 ohm resistor. Red LED1-2 cathodes connect only to Q1, green LED3-4 to Q2, yellow LED5-6 to Q3. **Disconnect the shared cathodes of the old circuit.** R8/R12/R14 connect each respective base to GND. Do not substitute BC547 without checking its pinout.

GPIO3 → R9 → C1 → piezo node. BZ1 and R10 are in parallel between this node and GND. C1 blocks sustained DC bias; R10 discharges the circuit. This does not protect against arbitrary impacts or ESD.

Never use: 5 V on GPIO; a low-impedance speaker or magnetic buzzer in place of the piezo; one shared resistor for all LEDs; simultaneous power from USB and the 5V/3V3 pins. Do not connect a battery holder directly to this circuit.

2. Firmware and startup

Arduino-ESP32 3.x

1. Open firmware/LumaMusic/LumaMusic.ino. Keep player.h alongside it.
2. Install the official esp32 by Espressif Systems package, version 3.x.
3. Select ESP32C3 Dev Module, 4MB Flash, USB CDC On Boot: Disabled for the official USB-UART board. Select the board port.
4. First run Verify and Upload without external components. Then disconnect USB before wiring.

Only host compilation and simulated hardware calls have been performed in this environment. **Building for ESP32-C3 and uploading to the board are still required.** Arduino-ESP32 2.x uses a different LEDC API and is not supported.

Test outside the enclosure

1. With power disconnected, check polarity, values and pinouts. Check for shorts and exposed conductors.
2. Test each group separately, starting with one LED, then add the second. Do not join cathodes across groups.
3. Connect a quality protected USB supply. Disconnect immediately if there is heat, odor, voltage sag or restarting.
4. Check startup, melody repeat, silence and reset. Measure the waveform if necessary.
5. Measure voltage across each LED resistor: I=U/R. With pulsed signals, a multimeter may show an average rather than a peak.

The program does not enable Wi-Fi/Bluetooth. On a detected error, it turns off the LEDs, stops further playback and attempts to detach PWM and drive LOW. **Simultaneous LEDC mute/detach/GPIO failure cannot guarantee physical silence.** Disconnect USB if behavior is abnormal. Host models test selected scenarios, not every hardware failure; no board testing has occurred.

Four patterns per cycle

R = red, G = green, Y = yellow.
0-8 s: R → G → Y, 500 ms steps, lit for 300 ms.
8-16 s: R+G → G+Y → Y+R, 1 s steps, lit for 650 ms.
16-24 s: a wave each second: R 0-350, G 250-600, Y 500-850 ms.
24-32 s: R, G+Y, G, R+Y, Y, R+G, R, Y; 500 ms steps, lit for 250 ms.
32-36 s: full pause. At most two groups are on in each logical frame.

Power

Use Micro-USB only for the first build. A ready-made USB power bank can be tried separately if it supports low loads without auto-shutdown. Its operation and dimensions have not been tested. **An internal battery version needs a separately selected holder, cells, protected converter and switch.** This circuit has no battery charger.

Do not bend or strike the piezo: it can generate voltage spikes. Notes at 1047-1568 Hz may sound quiet because the selected part resonates at 4 kHz. Do not increase voltage for more volume without redesign calculations.

3. LUMA compatibility

The original BREP and LUMA generator were checked. Original STL/BLEND files were not modified. These are digital-model measurements, not a physical fit test.

Parameter	Result
LED holes	26 total, nominal Ø5.4 mm. The prototype uses 6; the remaining 20 stay empty.
Tray	66×36×5.5 mm; platform top z=8.5 mm.
Neck clearance	19.5 mm from platform top to the lower neck edge in the source.
Placeholder envelope	A 50×28×14 mm box at (-25, -14, 10.5) does not intersect the base, tray or lid. This is not an actual board model with three switches.
Not included in fit check	Three switches, connectors, USB plug, wires, mounts, piezo, batteries, holder and protection. Actual fit is not confirmed.

Proposed positions: on each half, one LED at z=60 mm (70°), z=122 mm (90°), and z=179 mm (90°). These are generator coordinates. Insert LEDs from inside with lenses facing outward; flanges stay inside. A test print and separate insulating retention are required.

The selected Kingbright LEDs have Ø5±0.25 mm lenses and Ø5.9±0.25 mm flanges. Nominal clearance does not guarantee fit or retention in an actual FDM-printed hole.

The base has no designed USB entry or strain relief. Perform the first test only on a bench with the lid open. Do not close the lid over a wire. The official drawing’s 38.91 mm board dimension excludes the projecting antenna and is not treated as the overall size.

Software checks performed

49 note attacks; 32 seconds of music + 4 seconds of pause; 36,001 samples at 1 ms; four patterns and independent GPIOs; articulation; note boundaries and repeat; millis rollover; startup, frequency and PWM-detach failures. Ideal rounded frequencies differ by less than 1 cent. Run: bash tests/run_tests.sh.

At assumed 3.3 V and VCE=0.1 V: about 2.21 / 1.91 / 1.99 mA per red / green / yellow LED; 12.21 mA with all six on. Brightness has not been measurement-matched. Even at 3.6 V, a -5% resistor and a shorted LED, the branch-current bound is 5.57 mA and resistor power is 20.1 mW. This does not cover a short bypassing the resistor.

Not tested: actual board, sound, heating, voltage spikes, batteries or physical assembly. Do not leave an untested assembly unattended. Not a toy for young children.

4. Files and sources

In the archive: README.md with detailed instructions; firmware/LumaMusic with source code; schematic/ with the Rev C KiCad schematic and ERC; docs/LUMA_wiring.svg with a separate wiring illustration; tests with checks; checks with results; preview with an English-labelled synthetic MP4 and synthesized WAV audio. This PDF is also included.

The WAV is a computer-generated note sample, not a recording of the actual buzzer. Jingle Bells is the historical work by J. Pierpont; this is an original simplified monophonic arrangement, with no modern sound recording.

Official documentation

Espressif: board, power and pinout

Espressif: dimension drawing

Espressif: API LEDC

Kingbright: WP7113LID, red

Kingbright: WP7113LGD, green

Kingbright: WP7113LYD, yellow

onsemi: 2N3904

Murata: piezo catalog

Murata: driver circuits

Murata: impacts and voltage spikes

Murata: end of life

Library of Congress: 1857 edition

Next: confirm exact parts and dimensions, compile successfully and bench-test the circuit, then complete mounts, cable entry and a separate battery option. Until then, do not consider this design ready for enclosed operation.