PCB REQUIREMENTS – LED CONTROLLER (REV A)

1. MCU / Wireless
MCU shall be ESP32-C6. The design must support Wi-Fi 6 (2.4 GHz) and Bluetooth Low Energy (BLE). A certified ESP32-C6 module (e.g. WROOM / MINI) shall be used to simplify RF design and regulatory compliance. Proper decoupling and RF keep-out areas shall follow Espressif reference designs.

2. Power Supply (on the same PCB)
An AC/DC power supply shall be integrated on the main PCB (no external PSU). Input: 230 VAC. Output: 24 V DC sized for LED load requirements. Additional rails: 5 V and 3.3 V derived via buck or equivalent. Clear primary/secondary isolation, creepage and clearance shall be respected. Test points shall be provided for 24V, 5V, 3.3V and GND.

3. Inputs
3.1 230 VAC Button Input
One 230 VAC button input via screw terminal. The input shall be galvanically isolated using an optocoupler. The optocoupler output shall connect to an ESP32 GPIO, active LOW.

3.2 Low-Voltage Button Input
One low-voltage button input via screw terminal (Signal + GND). The button shall connect GPIO to GND, active LOW using internal pull-up.

4. LED Outputs
Two independent LED outputs, each with its own ESP32 GPIO.
Each output shall be provided via a 3-pin screw terminal: +24V, DATA, GND. Data signals shall be level shifted to 5V logic. Series resistors (~330 Ohm) shall be placed close to the driver. Adequate decoupling and optional ESD protection shall be included.

5. Future Expansion – Microphone Connector
The PCB shall include an unpopulated footprint for a small board-to-wire connector to support a future external digital microphone. The connector shall expose 3.3V, GND and reserved ESP32-C6 GPIOs suitable for digital audio (PDM preferred, I2S acceptable). No microphone shall be populated in the initial revision.

6. Programming & Debug
Programming pads shall be provided for 3.3V, GND, EN, IO0 and UART TX/RX. Pads shall be accessible for pogo-pin programming.

7. General PCB Requirements
Clear separation between high-voltage (230 VAC) and low-voltage circuitry. All external connections shall use screw terminals. PCB layout shall prioritize robustness, EMC performance and serviceability.

8. Compliance & Certification Requirements
The product shall be designed to support CE conformity for sale within the European Union. The design shall comply with applicable EU directives, including but not limited to: Low Voltage Directive (LVD) 2014/35/EU EMC Directive 2014/30/EU Radio Equipment Directive (RED) 2014/53/EU

RoHS Directive 2011/65/EU All components shall be RoHS compliant. Where applicable, harmonized EN standards shall be followed to demonstrate conformity. Certified radio modules and power supply solutions are preferred to reduce compliance risk.