

ESP32-S3 + 8 OLED (SSD1306) Real-Time VU Meter Design Conversation Summary: Brian wants to use eight SPI SSD1306 128x64 OLEDs for real-time VU meters at 25–60 FPS. After testing I2C OLEDs and finding them too slow, he's switching to SPI with a XIAO ESP32-S3. Hardware Decision: - Chosen board: XIAO ESP32-S3 (fast SPI, DMA, low cost, flexible pin mapping) - Display: SSD1306 SPI modules (7-pin type: GND, VCC, D0, D1, RES, DC, CS) - Total: 8 displays Connection Plan: Shared lines: SCK (D0), MOSI (D1), DC, RES Unique CS per display via a 74HC138 3-to-8 decoder. A0 = GPIO 1, A1 = GPIO 2, A2 = GPIO 3 on the ESP32-S3. Outputs Y0–Y7 drive each OLED's CS. SPI speed: 8–10 MHz (safe for 8 modules on one PCB). Power: Each OLED  $\approx$  20–25 mA, total  $\approx$  200–300 mA at 3.3V. Provide a solid 3.3V rail with local decoupling (0.1  $\mu$ F + 10  $\mu$ F per OLED). Performance: SPI bandwidth at 8 MHz easily supports 8x SSD1306 at 60 FPS ( $\approx$ 3.9 Mbps data). Peak-hold and bar-graph animation fully feasible using DMA SPI transfers. Arduino Sketch Summary: The code initializes all 8 SSD1306 modules via the 74HC138 decoder, updates 8 framebuffers, renders bar graphs with peak-hold, and achieves  $\sim$ 60 FPS refresh. Key Features: - Shared SPI bus with addressable CS via 74HC138. - Per-display framebuffer (1 KB each). - Real-time update loop using double-buffered DMA SPI. - Peak-hold decay logic for smooth animation. Next Steps: 1. Verify wiring on one OLED (Y0) before connecting all eight. 2. Tune SPI frequency and peak decay rate. 3. Optionally add color or vertical mode renderer later.