

Arduino UNO ADC Shield

Overview

The Arduino UNO ADC Shield is a custom-designed expansion board that fits directly on top of the Arduino UNO, matching its exact header alignment and mechanical form factor. It extends the UNO's functionality with additional analog-to-digital conversion, an onboard startup LED, and a prototyping area for custom circuit development.

Key Features

- **Form Factor:** Fully compatible with Arduino UNO R3 header layout
- **Prototyping Area:** 9 × 17 through-hole grid
 - First and last rows interconnected (ideal for Power and GND rails)
 - Flexible prototyping section for sensors, filters, and small sub-circuits
- **Startup LED:** Power-on indicator (D1) with a 660 Ω current-limiting resistor
- **Extended ADC Capability:**
 - **MCP3204 – 12-bit ADC converter:**
 - Expands UNO's native 10-bit ADC to 12-bit precision (4096 discrete levels)
 - SPI interface (CLK, MISO, MOSI, CS) connected to Arduino digital pins
 - Four input channels (CH0–CH3) for multiple analog sensors
 - **MCP6001 Op-Amp:** Configured as a unity-gain buffer (voltage follower)
 - Stabilizes and isolates high-impedance sensor outputs before ADC input
 - Ensures accurate sampling and prevents loading effects on sensors
- **Headers:** Standard Arduino-compatible headers for stacking other shields or connecting external modules

Functional Description

1. Startup LED Section

- Simple visual indicator showing when the board or Arduino is powered on.

2. Analog Front-End (ADC + Buffer)

- MCP6001 buffers analog signals to improve precision and protect sensor outputs.

- MCP3204 performs 12-bit analog-to-digital conversion, interfacing via SPI.
- The user may select AREF or +5 V as the ADC reference voltage.

3. Prototype Area

- Designed for experimentation, testing small analog/digital circuits, or adding custom modules.
- Top and bottom rows can serve as +5 V and GND lines for convenience.

PCB Design Highlights

- Compact 2-layer design in KiCad with full ground plane coverage for noise reduction.
- Optimized SPI routing and short analog traces for reduced interference.
- Header alignment and hole spacing precisely match the Arduino UNO R3 standard.
- Reserved J5 connector for ADC input expansion.
- Clean silkscreen labeling for clarity and educational use.

Applications

- Analog sensor interfacing and high-resolution measurement
- Educational projects requiring extended ADC performance
- Custom Arduino-based instrumentation
- Prototyping platform for rapid testing and development