

# ESP32-EASY-PROTO-V2

## Comprehensive Technical Documentation

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## 1. Introduction

The **ESP32-EASY-PROTO-V2** is an **educational and prototyping platform** developed by **Lucienne Swart at Micro Robotics**, in collaboration with the **University of Pretoria**.

This board integrates the **ESP32** microcontroller (Wi-Fi + Bluetooth), multiple onboard sensors and peripherals (OLED, buzzer, IR, WS2812B LED), and a **flexible power design** supporting **7–30 V DC** or **USB 5 V**. With **screw terminals** exposing the ESP32 GPIOs, it simplifies prototyping, testing, and educational use.

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## 2. Key Features

### 1. ESP32 (38-pin) + CP2102

- USB-C interface for convenient programming/debugging.

### 2. Wide Voltage Input

- Accepts **7–30 V DC** at the barrel jack, regulated by **LM2596** (5 V) and **AMS1117** (3.3 V).
- **Diode OR-ing** ensures safe use of DC + USB simultaneously, prioritizing DC.

### 3. Onboard Sensors

- **LSM6DS3TR-C** (accelerometer + gyroscope),
- **HDC1080DMBR** (temperature + humidity),
- **LPS22HBTR** (pressure).

### 4. Additional Peripherals

- **0.96" OLED** (I2C)
- **MicroSD** (SPI)
- **IR Receiver, photoresistor, potentiometer, push buttons**
- **Buzzer** (with 2N7002 MOSFET & 1N4001 diode)
- **WS2812B RGB LED** with **TXB0101DBVR** level shifter (3.3 V → 5 V data)

## 5. Dedicated Board Rails

- Sensors/peripherals power from 5 V or 3.3 V rails (**not** from the ESP32 regulator) to protect the MCU.

## 6. Indicators & Screw Terminals

- Blue LED (GPIO2), Red LED (GPIO15).
  - CN1..CN5, CN7..CN8 break out ESP32 pins; CN6 for power rails.
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## 3. Technical Specifications

### 3.1 ESP32 Module and Compatibility

- **Module:** ESP32-WROOM-32E
- **Compatible Micro Robotics Boards:**
  - **ESP32-CP2102-USBC**
  - **ESP32-DEV-CP2102-C**
- **Supply & Logic Voltage:** 3.3 V internal; can accept 3.3 V ~ 5 V supply.
- **Memory:** 448 KB ROM, 520 KB SRAM + 16 KB RTC SRAM, 4 MB SPI Flash
- **Wireless:** 2.4 GHz Wi-Fi, Bluetooth Classic + BLE

### 3.2 Power Architecture

#### 1. DC Jack (7–30 V)

- **LM2596** → 5 V
- **AMS1117** → 3.3 V

#### 2. USB 5 V

- By default, powers only the ESP32.
- Optional bridging to power entire board, bypassing diode OR-ing.

#### 3. Diode OR-ing

- Schottky diodes manage DC + USB concurrency; DC is prioritized.

### 3.3 Sensors and Peripherals

1. **LSM6DS3TR-C** – IMU (I2C 0x6A)
2. **HDC1080DMBR** – Temp/Humidity (I2C 0x40)
3. **LPS22HBTR** – Pressure (I2C 0x5C)
4. **OLED** (0.96", I2C 0x3C)
5. **MicroSD** (SPI: CS=GPIO5, SCK=GPIO18, MISO=GPIO19, MOSI=GPIO23)
6. **Buzzer** (GPIO27, with 2N7002 + 1N4001)
7. **WS2812B** (GPIO4, level-shifted by TXB0101DBVR)
8. **Potentiometer** (GPIO34)
9. **Photoresistor** (GPIO35)
10. **IR Receiver** (GPIO36)
11. **Push Buttons** (GPIO32 & GPIO33)
12. **LEDs**: Blue (GPIO2), Red (GPIO15)

### 3.4 Operating Conditions

- **Environment**: Clean, dry, low humidity
- **Temperature Range**: ~-40 °C to +85 °C (ESP32 core)

### 3.5 PCB Material and Mechanical Specs

- **Board Material**: FR-4 (Standard TG ~135–140)
- **Number of Layers**: 2
- **Dimensions**: 136.7 mm × 90 mm
- **Board Thickness**: 1.6 mm
- **Surface Finish**: HASL (with lead)
- **Solder Mask Color**: Black, Silkscreen: White
- **Tenting**: Vias are tented; no impedance control
- **Edge Plating**: No
- **Gold Fingers**: No
- **Electrical Test**: Flying Probe random test (IPC Class 2 Standard)

- **Solder Paste:** Sn96.5%, Ag3.0%, Cu0.5% (260 °C)
- **Board Outline Tolerance:** ±0.2 mm
- **Mounting Holes:** **Four corner holes** designed for **rubber feet** or enclosure mounting.
- **Deburring/Edge Rounding:** None

**Product Manufacturing Type:** Industrial/Consumer electronics

**Mark on PCB:** 2D barcode (Serial Number)

## 4. Pinout and Interface Details

### 4.1 GPIO Assignments

GPIO	Function / Peripheral
GPIO2	Blue LED (onboard)
GPIO4	WS2812B LED (w/ TXB0101 level shifter for 5 V)
GPIO5	SD Card CS
GPIO13	INT1 (LSM6DS3TR-C)
GPIO15	Red LED (onboard)
GPIO18	SD Card SCK
GPIO19	SD Card MISO
GPIO21	I2C SDA (Sensors + OLED)
GPIO22	I2C SCL (Sensors + OLED)
GPIO23	SD Card MOSI
GPIO25	INT2 (LSM6DS3TR-C)
GPIO27	Buzzer (2N7002 + 1N4001)
GPIO32	SW1 (Push Button)
GPIO33	SW2 (Push Button)

GPIO	Function / Peripheral
GPIO34	Potentiometer (RK09D1130C3W)
GPIO35	Photoresistor (GT36516)
GPIO36	IR Receiver (IRM-H638T/TR2) <b>(CN2 swap note)</b>
GPIO39	INT (LPS22HBTR) <b>(CN2 swap note)</b>

#### 4.2 SD Card (SPI)

Signal	GPIO
CS	GPIO5
SCK	GPIO18
MISO	GPIO19
MOSI	GPIO23

#### 4.3 I2C Devices and Addresses

Device	Address	GPIO SDA/SCL
LSM6DS3TR-C	0x6A	21 / 22
HDC1080DMBR	0x40	21 / 22
LPS22HBTR	0x5C	21 / 22
OLED (0.96")	0x3C	21 / 22

#### 4.4 Screw Terminal Mapping

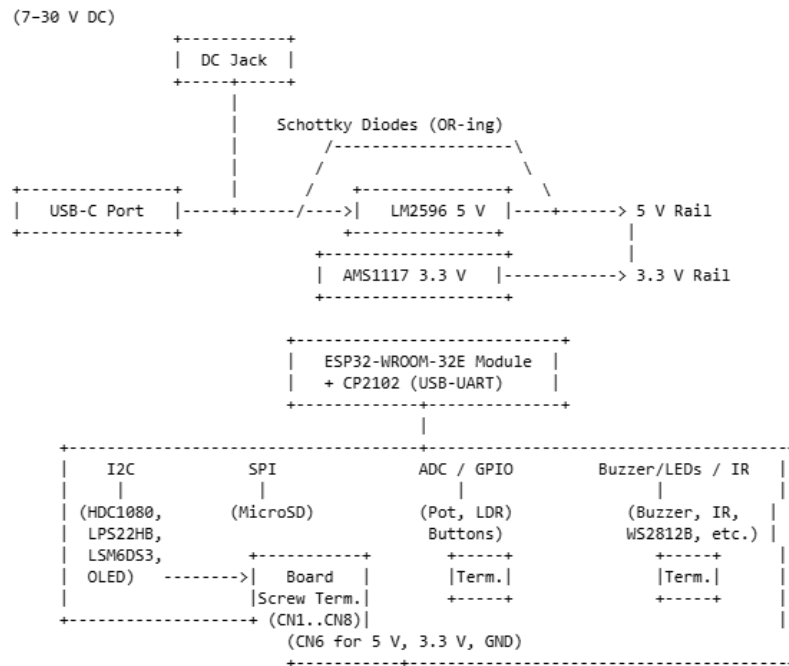
- **CN1..CN5, CN7..CN8:** GPIO breakout (including GND)
- **CN6:** Board power rails (5 V, 3.3 V, GND)

#### 4.5 Known Silkscreen Error: GPIO36 and GPIO39 Swap

A **labeling mistake** on certain terminals swaps **GPIO36** ↔ **GPIO39**. Refer to the schematic or netlist to confirm correct connections.

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## 5. Block Diagram and Board Layout



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## 6. Assembly and Production

### 1. Assembly

- Shipped with SMD components installed (ESP32, LM2596, AMS1117, sensors).
- Screw terminals and pin headers may be shipped loose for user installation.

### 2. Bill of Materials (BOM)

- Reference designators (U1=ESP32, Q1=2N7002, etc.).

### 3. Manufacturing Files

- Gerber
- BOM (CSV / Excel)

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## 7. Firmware and Software

### 1. Default Firmware

- Usually blank.

### 2. Recommended IDEs

- **Arduino IDE** (ESP32 boards)
- **PlatformIO**
- **ESP-IDF** (Espressif official)

### 3. Libraries

- **I2C Sensors:** Adafruit or SparkFun for LSM6DS3, HDC1080, LPS22HB
- **OLED:** Adafruit SSD1306 / U8g2
- **IR:** IRremoteESP8266
- **WS2812B:** Adafruit NeoPixel / FastLED (via TXB0101 level shift)
- **SD:** Built-in Arduino SD or ESP-IDF SDSPI

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## 8. Setup and Usage Instructions

### 1. Power Up

- **DC Jack Input** (7–30 V): Board rails at 5 V (LM2596) & 3.3 V (AMS1117).
- **USB 5 V:** By default, only powers ESP32. Optional bridging to supply entire board (bypass diode OR-ing).

### 2. Programming

- Plug in USB-C, install CP2102 drivers.
- Select “ESP32 Dev Module” in Arduino or relevant environment.
- If auto-boot fails, hold **BOOT** (GPIO0=LOW) and press **EN**.

### 3. Initial Verification

- **I2C:** Scan addresses (0x6A, 0x40, 0x5C, 0x3C).
- **SPI:** Confirm SD read/write.



- **Analog:** Pot (GPIO34), LDR (GPIO35).
  - **Buzzer:** Drive GPIO27 (2N7002 gate).
  - **WS2812B:** Data on GPIO4 (3.3 V → 5 V via TXB0101).
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## 9. Troubleshooting and Support

- **No COM Port?**

- Ensure data USB cable, correct CP2102 driver. Note: ESP32 not detected or powered when using a USB C to USB C cable on computer USB C port.

- **Power Issues?**

- Check barrel jack polarity, bridging method if powering everything from USB 5 V.

- **Sensor/Peripheral Errors?**

- Re-check 3.3 V lines, I2C addresses, or SPI wiring.

- **Contact**

- Email: [support@microgroup.co.za](mailto:support@microgroup.co.za)
  - GitHub: [Repository URL]
  - Forum: [Community/University Discussion]
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## 10. Safety and Regulatory

### 1. Handling

- ESD-safe procedures when connecting or soldering external parts.
- Avoid bridging 5 V rails if unsure about power design.

### 2. Certifications

- ESP32 modules often have partial FCC/CE.

## 11. Licensing and Legal

### 1. Design License

#### **Design Ownership**

The ESP32-EASY-PROTO-V2 board and all associated design files (including schematic, PCB layout, BOM, and documentation) are **proprietary intellectual property** of Micro Robotics.

#### **Proprietary License**

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#### **Commercial Use and Sales**

Micro Robotics retains the exclusive right to manufacture and sell the ESP32-EASY-PROTO-V2 board. Third parties may not clone, replicate, or otherwise produce the board or its derivative works for commercial gain without an explicit licensing agreement from Micro Robotics.

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### 2. Disclaimer

- Provided “as is” for educational/prototyping; no warranty for mission-critical uses.

### 3. Acknowledgments

- **Lucienne Swart** (Micro Robotics) as the designer.
- University of Pretoria collaboration.
- Thanks to component manufacturers (Espressif, TI, ST, etc.).

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## 12. Future Developments and Roadmap

### 1. Hardware Enhancements

- Correct the **GPIO36 ↔ GPIO39** silkscreen swap in next revision.
- Introduce **GPIO isolation** and more robust ESD measures.
- **Reverse voltage protection**, **PTC fuses**, and **varistors** on power rails.
- **N-channel and P-channel MOSFETs** for smarter, safer power distribution.

### 2. Software Examples

- IR remote decoding, advanced sensor fusion (IMU + LPS22HB), data logging to SD demos on GitHub repo.

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## 13. References and Datasheets

### 1. ESP32

- [ESP32 Datasheet \(Espressif\)](#)

### 2. CP2102

- [Datasheet \(Silicon Labs\)](#)

### 3. LM2596S

- [Datasheet \(UMW\)](#)

### 4. AMS1117

- [Datasheet \(UMW\)](#)

### 5. LSM6DS3TR-C

- [Datasheet \(ST\)](#)

### 6. HDC1080

- [Datasheet \(TI\)](#)

### 7. LPS22HB

- [Datasheet \(ST\)](#)

### 8. MLT8530 Buzzer

- [Datasheet](#)

**9. GT36516 (Photoresistor)**

- [Datasheet](#)

**10. RK09D1130C3W (Pot)**

- [Datasheet](#)

**11. IRM-H638T/TR2 (IR)**

- [Datasheet](#)

**12. 0.96" OLED**

- [SSD1306 Datasheet](#)

**13. TXB0101DBVR (Level Shifter)**

- [Datasheet \(TI\)](#)

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**14. Document Revision**

- **Version:** 1.0
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- **Author / Maintainer:** *Lucienne Swart, Micro Robotics (PTY) LTD*

**End of Document**